NUTRITION

Monitoring and Assessment

edited by
Tara Gopaldas
and
Subadra Seshadri

772

India, like many developing countries, spends vast sums of money on nutrition programmes. However, the complex criteria for evaluating the efficacy of such programmes, and, at a micro-level, of the effect of such programmes on the undernourished individual, lack a substantial literature. In order to fill this gap the M.S. University of Baroda (which has a renowned Nutrition Department), in collaboration with UNICEF, has put together this set of papers by eminent experts on nutrition. This book of papers discusses succinctly what indicators and techniques can be used to monitor nutrition, with what level of accuracy and under what field conditions.

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Foreword

Monitoring and assessment form the cornerstone of all planning and implementational activities. Our massive national nutritional programmes *all* require high calibre and well-trained personnel to design and conduct such monitoring and evaluation exercises. It was, therefore, considered imperative to offer a special course in nutritional monitoring and assessment to the postgraduate students at the Department of Foods and Nutrition, M. S. University of Baroda. There are, no doubt, some manuals, monographs, and texts on the subject—the most widely used one perhaps being the WHO monograph, *Nutritional Assessment in the Community* by D. B. Jelliffe (1966). However, all these source materials come from outside India. Another important consideration was the recent recognition by the scientific community of the need for much more nutrition intervention research and process evaluation. Such studies cannot be carried out without well-oriented researchers and field investigators. It was felt that it would help not only our proposed postgraduate course but also several other postgraduate research and academic institutions if we could mesh the tremendous expertise and experience on the subject that already exists in India.

Hence, a workshop on Nutritional Field Monitoring and Assessment was planned. In this effort, all my colleagues and students enthusiastically helped and shouldered many organizational responsibilities. However, two of my colleagues, namely, Professor Sunder Gujral and Mrs Subadra Seshadri, stand out for having assisted me in listing a series of topics which we felt both postgraduate teachers as well as postgraduate students required to know in order to be in the forefront of surveys and studies involving nutritional monitoring and/or assessment. In the process of selecting topics we asked ourselves what areas required clearer definition, fresh thinking and greater introspection. We also considered which areas were very important but blurred. Out of such questioning emerged twelve major topic areas.

Next we required a generous sponsor to meet the expenses of the workshop. But for the generosity of UNICEF, New Delhi and the personal involvement of Dr Sam Dalal, Senior Programme Officer, UNICEF, New Delhi, this workshop would not have materialized.

No less than 20 national and international experts in the field were invited to share their experience and insights at this workshop. Most of the speakers invited were good enough to send their manuscripts to us well in advance. Each paper was presented by an expert and was summed

up and further delineated by an expert discussant. This led to presentations and discussions of a high technical order.

Shri M. S. Dayal, IAS, Joint Secretary, Ministry of Social Welfare (now re-named Ministry of Human Resource Development), Government of India, set the tone by his excellent inaugural address on the assessment of national nutrition programmes. Dr D. N. Kakkar, the noted social anthropologist and Deputy Director General, ICMR (Special Cell), New Delhi added an anthropological and sociological dimension to the topic with his paper, 'The Concept of Nutritional Field Monitoring and Evaluation: the Whys and Wherefores.' Dr Umesh Kapil, Senior Scientific Officer, added valuable insights to this presentation as a discussant. Dr Sheela Talwalkar, Statistical Officer, Ciba Geigy Research Unit, Bombay and Shri J. G. Shastry, Assistant Director, National Institute of Nutrition, combined to give a masterly presentation and discussion on 'Appropriate Sampling Methods and Statistical Applications for Nutrition Monitoring and Evaluation'. Dr Prema Ramachandran, the noted expert in maternal nutrition, could not be present in person. However, the discussant Dr Kamala Gopal Rao, Programme Officer, UNICEF, New Delhi did an excellent job of both presenting and discussing the topic, 'Use of Socio-economic and Mortality Data for Assessment of Nutritional Status'. Professor Tara Gopaldas dealt with the topic 'Process Evaluation—A New and 'Important Concept' and exemplified her talk with case studies. Dr K. Vijayaraghavan ably assisted by Dr Mrunalini Puar, Professor Sunder Gujral and Dr U. V. Mani presented and discussed the important topic of 'Invasive Parameters, Biological Specimens, their Sensitivity, Specificity and Cost'. Dr M. C. Swaminathan's excellent paper on 'Non-invasive Parameters for Field Monitoring and Evaluation: their Sensitivity, Specificity and Cost' was read out by Professor Gujral. The topic, 'The Unexplored Realms of Social Monitoring/ Evaluation and Social Accountability of Nutrition Programmes' was presented by a young planner—Dr Ashok Iyengar of the Planning Commission of India and was thought-provoking. The topic 'Indicators for Monitoring and Evaluation of Nutritional Status in the Primary and Middle School Age Group (6–15 years)' was dealt with by Professor Tara Gopaldas.

Dr Kalyan Bagchi, Nutrition Advisor, ICMR, New Delhi unfortunately could not be present on this occasion to share with us his valuable experience on the 'Evaluation of Nutrition Education'. However, happily for us he sent his paper. Mrs Subadra Seshadri added some observations on certain issues in monitoring and evaluation of nutrition education programmes.

'Role and Development of National Nutrition Monitoring Bureau' was succinctly presented by Dr Prahalad Rao, Deputy Director of the

National Institute of Nutrition. The last and perhaps most difficult area—'The Grey Area of Cost-effectivensess and Cost-benefit Analysis of Nutrition Programmes', was admirably presented by Mrs Mary Ann Anderson, Nutrition Advisor, USAID, New Delhi.

All the speakers and discussants gave generously of their valuable time and expertise, culminating in a set of recommendations and this report.

Our thanks go to Miss Sissy Abraham, Workshop Officer, for painstakingly transcribing the taped talks of each speaker and discussant; Miss Anima Saxena and Miss Uma Iyer for assisting in the compilation of the papers; and Shri B. M. Khaire for typing the entire manuscript.

We greatly appreciate the generous grant made available by UNICEF in order to bring out this report in volume form.

Tara Gopaldas

Introduction

M. S. DAYAL

The subject of the seminar out of which this book has emerged is of great interest to the Ministry of Social Welfare. The seminar highlighted three words—nutrition, monitoring and assessment.

Nutrition here obviously refers to nutrition of human beings, and if you accept the human being as an entity consisting of a physical body and organs of perception, action and mind, then the purpose of nutrition should obviously be to achieve an acceptable level of physical and mental activity in human beings. That would lead us, to some extent, to determine the scope of nutritional monitoring and assessment. As far as mental activity is concerned, although it is related to the physical well-being of man, it is also a function of education.

Monitoring could be defined as a continuous process of overseeing or review of the implementation of an activity to ensure that inputs are flowing, that work schedules are being adhered to and that outputs are being achieved according to a plan.

We can define assessment as measurement of a status or a situation. Thus, nutritional assessment would mean measurement of nutritional status of an individual, a family, a household, a community or specified groups of people. But obviously, measurement implies existence of some acceptable indicators and tools.

If these terms are put together, they constitute what we may understand by nutrition monitoring and assessment.

So, when we are thinking in terms of grey areas of monitoring and assessment, we have to limit its scope in a manner that is acceptable. We use concepts and methods which are clear, easy to apply, simple and reliable. However, if we were to look at nutritional status with reference to the ultimate objective of an optimum level of physical and mental activity, then the work becomes very difficult, time-consuming and fraught with all sorts of disputed issues. Therefore, the scope of nutritional monitoring and assessment will have to be limited to specific purposes.

One purpose may be long-term planning and perhaps we can allow

some time for the studies. But there are other purposes like timely warning so that interventions are possible in order to prevent and manage emergencies. Another purpose may be to identify medium-term and immediate nutrition problems so that one can develop programmes and manage them in order to tackle these medium-term and immediate problems. To fulfil these purposes, the system of nutritional monitoring and assessment should not only be able to provide timely information but should also employ methods which are of fairly high validity and reliability and at the same time, easy to apply.

You could think of nutritional monitoring and assessment measures in three ways. These are indirect measures like infant mortality or even early childhood mortality in the age group of 12 to 60 months. Even qualitative information about the situation of crops will give an idea of the impending nutritional situation; knowledge about the staple foods that people eat; awareness of some nutritional problems they are likely to face; prevalent food prices; wages; and the existence of certain diseases. For instance, if there is an epidemic of malaria you can assume that even if plenty of food is available, there will be a large number of malnourished people. If there is an epidemic of gastroenteritis, it can be assumed that there will be accompanying malnutrition. These are a few indirect measures which give you some information about the nutritional situation either for the society or for individuals in particular localities.

There are more direct measures which could be used for global assessment or for assessment at the level of an individual. Such direct measures would include level of food production and food availability which would include crop yields, market data, imports and exports; dietary surveys; and nutritional status surveys which would include, apart from some sociological data, data on clinical examination, biochemical tests and anthropometry.

In times of natural disasters, there are some other indicators too. For instance, there may be considerably reduced capacity for physical activity and yet people may have to travel long distances in order to have access to food, as happens in famines. Sometimes, there may be indicators of an obvious decline in human moral and social values as a result of acute food scarcity. There may be a considerably increased incidence of disease and infection. These indicate the situation of malnutrition in times of disaster.

Whatever measures are being used, whether these are indirect or direct or whether they are used in disaster situations, they must have certain requisites if they are to be reliable and to be used effectively. People are needed, they have to be trained, a system of reporting must be in existence, and also a system by which information flows. There

must be supervision of all these personnel, their training and their reporting.

The measures for assessment of nutritional situations become beneficial or more useful if the system is truly simple and is so easy to apply that it can be established almost as routine. We have in our country, at least on certain aspects, information flowing regularly which has led to the adoption of some useful practices.

Although it may not be possible to maintain adequate levels of nutrition in times of natural disasters, survival is now assured. Information reaches well in time to enable the government as well as voluntary organizations to initiate steps to tackle the problem.

All measures of nutritional status have certain advantages. They serve as shorthand indicators of health, welfare and survival of individuals and communities. They help us in identifying individuals who are in need of special attention. Most of these measures are quite cheap. It is easier to collect information with respect to these measures than on other indices like poverty, level of housing or sanitation and hygiene.

But all measures have their limitations too. Indicators have to be selected in relation to the system to be studied. The measures will change depending on whether you are studying the individual system, or the family, or communities, or special groups of people.

1 The Concept of Nutritional Field Monitoring and Evaluation: the Whys and Wherefores

D. N. KAKKAR

The concept of 'nutritional surveillance' is concerned with everything that affects nutrition from food production, storage and distribution and intake to health status itself. The need for nutritional surveillance arises from the fact that the main cause of malnutrition in developing countries is poverty. However, poverty alone does not cause malnutrition. Since malnutrition is a multifaceted problem, it needs to be studied from a holistic point of view. Our studies in Punjab enabled us to identify many interacting factors which had some association with severe malnutrition in the physical, biological and cultural environment. Broadly speaking, the incidence of severe malnutrition was higher among the scheduled castes and backward classes as compared to the non-scheduled castes. This reflected several factors including absence of land holdings, low income, poor housing, large family size, defective pattern of child rearing, and reliance on folk medicine practices even for the treatment of certain critical illnesses.

Undoubtedly an understanding of the relationship between socio-cultural background and malnutrition is essential for the development of an adequate system of nutritional field monitoring. This paper will discuss how nutritional field monitoring was done in rural Punjab where the Indian Council of Medical Research, in collaboration with the Johns Hopkins University, conducted a major study on interactions of nutrition and infections in which the author worked as one of the principal investigators.

BACKGROUND OF THE NARANGWAL STUDY

The main policy issue underlying the Narangwal study was to determine whether there was synergism of programmes to control malnutrition and infection similar to the known synergism between these problems.

The following were some of the policy questions which led to the Narangwal study:

i. Can nutrition interventions reduce the incidence, duration and impact of infections?
ii. Can control of infection improve nutritional status?
iii. Is there a synergism in programme effects so that a combined nutrition and infection control programme would have a greater impact on cost-effectiveness than what would be expected from each programme alone?
iv. Can better field programmes be developed to combine the most effective measures against malnutrition and infection so that these measures can be implemented within the existing constraints?

Ten study villages in the nutrition project were selected in clusters of two to three villages scattered around two to three community development blocks. The best possible efforts were made to get reasonable comparability between the different groups of villages in terms of major socio-cultural and economic indicators. Careful attention was paid to keeping the village clusters separated to minimize communication between them about differences in the packages that were offered to them. Efforts were made to assess the true potential of each village in terms of its willingness and cooperation in relation to the service interventions that were provided to it according to the objectives of the study.

OBJECTIVES OF THE STUDY

Research Objectives

(a) To measure the extent to which health care, mainly focused on infectious disease control, influenced morbidity prevalence, mortality and nutrition status.
(b) To determine the effects of nutrition care, consisting of nutrition education and selective supplementation, on child growth and development, mortality and infectious disease experience.
(c) To determine the effects of combined nutrition care and health care on the same indicators of child health.
(d) To determine the influence of selected socio-economic and demographic factors on each of these interactions.

Applied Research Objectives

To evolve practical field procedures for implementing service programmes that are effective, feasible, cost-effective and within the administrative constraints of rural health services for:

(a) Selected nutrition care measures;

(b) Selected infection control and health care measures;
(c) Finding the optimal functional combination of both nutrition care and health care measures; and
(d) Defining the population characteristics, such as age of child, which determine when each component of the integrated care package can be most effectively and efficiently introduced.

The service packages received by the selected villages were (1) nutrition care, (2) health care, mainly concentrating on infection control and (3) integrated services (both nutrition and health care). In addition, there was a control group of villages. The entire field experiment was conducted from 1969 to 1973 in these villages. Actually, preparatory work was started in 1967 which included preliminary surveys of anthropometric status and morbidity; selection of study villages; standardizing methods for data collection and health services; staff training; and establishment of rapport with the local population. One of our major concerns was to attain a high level of quality control in data collection. Prior methodological experience in the Khanna and Guatemalan studies proved of considerable help in selecting variables to be measured. Careful attention was paid to the development of intervention packages. In the analysis, an attempt was made to find out the interrelationships between the complex interacting variables concerning nutritional status, morbidity and mortality. It was hypothesized that, in addition to their direct effects, poor nutrition would adversely affect morbidity, and high morbidity would decrease nutritional level; and that poor nutrition and high morbidity together would act synergistically in raising child mortality. Some of the results of the Narangwal study are discussed below.

RESULTS

Growth and Development

i. Nutrition care alone or in combination with health care significantly improved both weight and height of the children studied beyond 17 months of age.
ii. At 36 months, children from the nutrition care villages weighed on an average 560 g more and were 1.3 cm taller than children in the control villages.
iii. Children in the health care villages had mean weights and heights intermediate between those in the nutrition care and control villages.
iv. Of the socio-economic and demographic variables, sex and caste were shown to have an especially pronounced and additive effect which ranged from 0.6 to 0.75 kg in weight and about 2 cm in height. A male high-caste child from a nutrition care village averaged about

2 kg more in weight and 6 cm in height at 36 months of age than a female low-caste child from a control village.

Thus, this is the first project to show in a controlled experiment significant differences in average growth rate of all children in communities receiving specific nutrition and health inputs. Results from regression analysis on a sub-sample of 180 children on whom exact dietary measurements were obtained showed a strong correlation between dietary intake and achieved anthropometric status. Psychomotor development was found to have been directly affected by past nutritional status.

Morbidity

i. There was a significant reduction in the average duration of episodes of infectious disease in health care villages or nutrition and health care villages as compared to villages without health care.
ii. In health care villages each episode of diarrhoeal disease was reduced on the average by two days, lower respiratory tract infection by 1½ days, fever by 1 day, cough by 2½ days, and skin infections by 1½ days in comparison with villages without health care.

Mortality

i. Prenatal mortality was significantly reduced in nutrition care villages (31 per 1000 live and still births) as compared to health care villages (45 per 1000 live and still births). This decline in mortality probably resulted from improved nutritional supplementation to pregnant mothers.
ii. Neonatal, post neonatal and 1 to 2 year mortality were reduced to one half in the villages where services for control of infectious diseases were provided as compared to the control villages.
iii. Nutrition care produced an intermediate effect under one year of age and an equivalent effect on mortality among 1 to 2 year old children.

MONITORING AND EVALUATION

A system was developed to monitor the effectiveness of project services which included the following procedures:

i. A simple method for immediately reporting deaths of children under 3 years in village homes.
ii. A method to determine the most probable cause of deaths.
iii. Weekly meetings of supervisors and field staff at which reported deaths were discussed.
iv. Discussion of changes in morbidity patterns and other related topics and review of service records. Holding of meetings also in the subcentre villages.

v. Revision of standing orders and other procedures based on the results of these discusions.
vi. Re-training of the staff in regular, bi-weekly in-service training sessions.
vii. Maintaining high priority files for follow-up of children at increased risk of illness or death because of anaemia, tuberculosis, malnutrition etc. Because of this procedure, of the three selected health problems, the situation in respect of diarrhoea and pneumonia improved dramatically in response to surveillance and early treatment. However, reduction in neonatal tetanus was mainly brought about by immunization.

The evaluation of the programme was attempted by a separate team. The following field methods from the functional analysis research project were adopted:

i. Work sampling which produced detailed information on the time spent by project staff in providing specific services in the study villages. Observers kept track of all service tasks on at least 24 days sampled throughout one year of the project, recording the functions and activities performed at two-minute intervals on the observation days.
ii. Information was abstracted from individual service records for all years of the project. These data consisted of a description and count of all project services.

In conclusion, the task of improving nutrition is a problem of 'cultural construction', in which the collaborative efforts of nutritionists, food technologists, social scientists and particularly medical anthropologists, are required.

2 Appropriate Sampling Methods and Statistical Applications for Nutrition Monitoring and Evaluation

SHEELA TALWALKAR

The most critical aspects of sample designs are practicability and estimability of the various population parameters along with the estimability of the sampling variants. In order to arrive at uniform conclusions while dealing with a great diversity of practical problems, the statistician realizes that his designs may not follow theoretical considerations and mathematical specifications very strictly. Yet, when he aspires for excellence, the design of a sample survey approximates the optimum design, which is called a proximal design.

In practice, the most popular proximal design is the stratified multistage sampling design. The stratification provides opportunities to combine simplicity and flexibility and it also helps to reduce the sampling variants and to disperse samples over the population so that it really becomes a representative sample.

The World Fertility Survey (WFS) has provided ample evidence that in the majority of the developing countries, suitable area frames with maps and clear boundaries and with reasonably small units of approximately known size are available. Therefore strict probability samples can be drawn in the second stage units or the ultimate area units. The most common criterion of stratification is the type of place, e.g. metropolitan or other cities, towns and villages. An opportunity for further stratification is provided if more than one second stage units are to be selected from each primary unit. One can effectively use the stratification when the cluster in each second stage unit is to be sampled. Income could be used for stratification (in household surveys), while farm size or the type of cultivation is the most common stratifier in agriculture. The cluster size is usually selected in such a way that the ratio of the total number of sampling units to be selected in the cluster to the total number of sampling units in the sub-sample is not very high. In the WFS, this ratio varied between 2.5 and 4.5 and the usual

cluster size was between 15 and 25. Whenever the ratio is higher it indicates that the ultimate area unit is very large and it should be split up further.

The second aspect is the estimation of the error variants. The error variants consist of two components: (1) sampling errors, and (2) non-sampling errors. Ideally all components of sampling variants should be known before the sample is designed but in practice this never happens. But for optimization, the ratio of the variants of the 1st stage and 2nd stage units needs to be known. One summary measure of this ratio is the intracluster correlation coefficient which in turn is proportional to the average cluster size. But the main problem relates to non-sampling errors. Non-sampling errors can be divided into biases and variable errors. The problems of non-coverage, non-response and response-biases fall into the first category. These types of errors occur because of complicated sampling designs or complicated field instructions. As a result future interviews never really take place. While one cannot really eliminate them, measures must be taken to reduce variable response errors. The errors due to interviewers, coders, supervisors etc. could be reduced by random allocation of sub-samples to the interviewers. This permits estimation of interviewer variants.

Both sampling and non-sampling errors, although important in the evaluation of the survey results, must be balanced while arriving at a proximal design. From the point of view of survey design some loss in efficiency may be justified if the errors can be estimated from the sample. Thus for the proximal design, practicability, simplicity and flexibility should take precedence in deciding an overall design. Departures from simple designs are justified only if the advantages to be gained are large.

Minor differences in cost and variations should be ignored particularly because finally one obtains only the estimates of the population parameters. These estimates may well be only rough estimates subject to considerable unreliability. But at the same time, while designing a survey, the design must be flexible enough to take advantage of the major differences in population structure and field costs. However, the paramount consideration has to be practicability. Wherever possible non-sampling errors should be eliminated or at least reduced. But if that is not possible they should be estimable. The design must allow for the estimation of these errors.

Goodman says 'However efficient a sample may be, if it makes great demands on the field worker for its implementation, it may be carried through so badly that the undertaking can no longer be called scientific. And the emphasis on science highlights the need for adhering to a thoroughly practicable, even if somewhat inefficient plan at all costs.'

3A Use of Socio-economic and Mortality Data for Assessment of Nutritional Status

PREMA RAMACHANDRAN

Requests for assessment of nutritional status are the most common among those received by practising nutritionists. These requests may come from national and international organizations, institutes or individuals. The nutritional assessment may be required to encompass nations, communities, vulnerable segments of communities or individuals. It may be done as a part of an exercise to document current status as compared with past status, or as a specific attempt to evaluate the impact of an intervention programme.

It is often assumed that the parameters used for assessment of nutritional status are well defined, their norms are well documented and they could be universally applied. However, even today, assessment of nutritional status especially in adults remains the most controversial and widely debated issue among nutritionists.

It has been suggested that assessment of nutritional status can be done using the following information:

i. Direct parameters, e.g. dietary intakes, anthropometric, biochemical and biophysical parameters.
ii. Indirect parameters, e.g. morbidity and mortality experience in the community especially age-specific mortality rates.
iii. Ecological parameters, e.g. socio-economic status, housing and environmental hygiene.

The nutritional status of an individual or community is affected by socio-economic and ecological factors. Therefore, these parameters are likely to serve as useful indirect indicators of human nutritional status. The impact of these factors on health and nutritional status has been evaluated through data on dietary intakes, anthropometric indices, clinical signs of nutritional deficiency, biochemical or biophysical parameters. These parameters are considered to be the direct indicators of nutritional status. Under-nutrition is associated with increased susceptibility to morbidity and consequent mortality. A variety of vital

statistics such as maternal, perinatal, infant and childhood mortality rates have, therefore, been considered as indirect indicators of the nutritional status of a community.

Collection and interpretation of each of these three types of information pose different types of problems. The usefulness of various direct, indirect and ecological indices for assessment of nutritional status under different circumstances is briefly reviewed in this paper.

DIRECT PARAMETERS FOR ASSESSMENT OF NUTRITIONAL STATUS

Dietary intake, anthropometric indices, presence of clinical deficiency signs and various biochemical and biophysical parameters have been widely used in nutrition surveys as direct indicators of nutritional status. The usefulness of various indirect and ecological indicators for the assessment of nutritional status is often evaluated by comparing them with direct indicators, especially data on anthropometric and dietary intake. It is, therefore, essential that the pitfalls in using these direct indices as indicators of nutritional status should be considered first before assessing the indirect and ecological indicators. The usefulness of these direct indicators for the assessment of nutritional status in childhood will be extensively reviewed elsewhere. In this paper an attempt is made to focus attention mainly on the use of these indices for the assessment of nutritional status in adult women.

DIETARY INTAKE

Dietary intake has been widely used as an indicator of nutritional status. The type of data from which dietary intakes have been computed range from community averages of food consumption, household diet surveys and carefully conducted diet surveys of food consumed by the household and individual by weighment or by 24-hour dietary recall. Data on community averages or even those collected through household diet surveys may not provide any information on dietary intake of the individuals or groups of individuals such as pregnant and lactating women. Individual diet surveys are tedious and time-consuming. They do not take into account possible day-to-day variations in dietary intake. Information on additional dietary intake in the form of supplements administered, with or without actual data on increase in total dietary intake has also been used as an indicator of change in nutritional status. In an environment of poverty, supplementary foods given to any individual are often shared by children. It is, therefore, difficult to assess the actual increment in dietary intake of the target person due to food supplements.

ANTHROPOMETRIC INDICES

In children, weight-for-height-for-age is the most widely used parameter for assessing growth and nutritional status. Chronic under-nutrition during infancy, childhood and adolescence might be associated with stunting. However, once adult height is reached, further deprivation would not have any impact on height.

Body weight and weight-for-height ratios are extensively used as indicators of nutritional status in adults. Sometimes additional information regarding mid-upper-arm-circumference and fat fold thickness might also be available. It is well documented that marked shifts in dietary intake, as in famine and acute starvation, result in significant weight loss in the community and in the individuals. Therefore, under conditions of acute severe nutritional deprivation, changes in body weight might provide a reliable indication of changes in dietary intake and nutritional status.

However, situations might be somewhat different under conditions of continued long-term low dietary intake. We still do not know to what extent variation in body weight indicates variation in the nutritional status of adults. Data from several sources suggest that there is very little correlation between habitual dietary intake and body weight in adults. Studies from Gambia have shown that consumption of food supplements of about 700 KCal per day for 12 months or longer did not result in alteration in body weight. It would, therefore, appear that variations or alterations in dietary intakes are not always associated with variations or alterations in body weight in adults.

Ample data exist to indicate that pregnant and lactating women from poorer segments of the population subsist on diets far below the R.D.A. In many developing countries there are established ongoing food supplementation programmes for these vulnerable segments of the population. Attempts have been made in the last few years to evaluate some of these programmes. One of the most widely used parameters for evaluation is body weight. Absence of change in body weight is often interpreted as an indication that the food supplements did not reach the target group. However, data from Gambia and elsewhere suggest that increase in dietary intake need not always be followed by weight gain.

It would, therefore, appear that it might not be wise to depend on change in body weight as the major parameter for evaluation of food supplementation programmes.

MORTALITY DATA

Ample data exist to indicate that severe degrees of under-nutrition are associated with depression of immune body production and increased

susceptibility to infection in communities where under-nutrition and infectious diseases constitute the most common causes of death. It is, therefore, logical to expect that mortality rates might give some indication of the nutritional status among deprived segments of the population. Mortality data have, therefore, been considered to be indirect indicators of nutritional status in a community.

There are two major problems involved in the use of mortality data as indirect indicators of nutritional status in a community: one is in data collection and the other is in the interpretation of data. Mortality data are used as a proxy variable for assessment of nutritional status because of the difficulties in collecting information on direct indicators, i.e. anthropometric, biochemical or biophysical parameters of nutritional status. It is usually quite difficult to get precise information regarding mortality in large population groups. Without precise data it is impossible to use mortality experience as an indicator of nutritional status. The second major problem is that of interpretation; the relative role of nutrition and coexisting adverse environmental factors and poor health care in causing death remains undefined. Even when collection of data is possible, it might be difficult to use the mortality data to draw sound conclusions regarding the nutritional status of the community. Crude mortality rates and age- and sex-specific mortality rates have in the past been used as indirect indicators of nutritional status.

CRUDE MORTALITY RATE

Famine and deaths due to famine should never occur in the modern era. However, massive shifts in population groups because of political upheaval result in acute severe food deprivation. Under such circumstances there are very few parameters to assess the severity of the food deprivation and the impact of relief measures. The only available figures might be of the total number of persons affected and the total number of deaths. Under such adverse conditions, until better organization is possible, death rates might constitute the only method by which the severity of the calamity and the impact of relief measures could be ascertained. However, under normal conditions crude death rate provides very little information regarding nutritional status of the community.

MATERNAL MORTALITY RATE

Acute severe food deprivation as in famine results in amenorrhoea and infertility. Maternal mortality rate is, therefore, not of any use as an indicator of acute severe nutritional stress.

Ample data exist to indicate that maternal mortality rates are several fold higher in undernourished women in developing countries as compared to well-nourished women in developed countries. However,

detailed analysis of data suggests that haemorrhage, infection and pregnancy-induced hypertension (toxaemia) are the major causes of death. Anaemia is an important associated factor contributing to maternal death. However, maternal under-nutrition *per se* is not a major factor responsible for the high maternal mortality rates in under-nourished communities.

Several studies have demonstrated that improvement in maternal care can bring about a dramatic reduction in maternal mortality rates without any significant improvement in maternal nutritional status. It is, therefore, unlikely that maternal mortality rates could serve as reliable indirect indicators of maternal nutritional status.

PERINATAL MORTALITY RATE

That poor maternal dietary intake, low birth weight and high perinatal mortality rate are associated was demonstrated in the early forties. In fact, many of the food supplementation programmes owe their origin to this recognized association between under-nutrition, maternal deprivation and high perinatal mortality rate. Detailed anaiysis of data, however, showed that the association may not be causal. Under-nutrition is but a facet of poor utilization of health care which results in a high incidence of low birth weight and perinatal mortality. Some of the data from small-scale carefully supervised nutrition supplementation studies have shown that the improvement in birth weight and reduction in perinatal mortality rates may not be commensurate with the increased dietary intake. Other studies have shown that the provision of prenatal care might result in a significant rise in birth weight and reduction in perinatal mortality rates without any alteration in the maternal nutritional status. Thus, though some association between poverty, maternal under-nutrition and high perinatal mortality rates exists, it is not causal; and change in one may not necessarily be associated with change in the other.

INFANT MORTALITY RATE

In most of the developing countries breast-feeding remains almost universal during the first year of life. Severe forms of malnutrition are relatively uncommon among breast-fed infants. Infant mortality rates (IMR) in many of these countries are high and are mostly due to infections. Association between high infant mortality, poverty and under-nutrition undoubtedly exists. Under some circumstances IMR serves as a sensitive indicator of infant nutritional status. Wyon and Gordon showed the impact of weaning diarrhoea on infant nutritional status and an associated increase in age-specific mortality rate during the

same period in infancy. Several investigators have shown that the early introduction of supplements to breast-fed infants under unhygienic conditions results in increased morbidity and deterioration of infant nutritional status, as well as an associated sharp increase in mortality at the time of introduction of the supplements. It is, therefore, possible that under some circumstances IMR may provide valuable clues regarding trends in infant nutritional status. However, since several factors other than nutritional status, such as birth weight, gestational age at birth and infections play a major role as determinants of infant mortality, IMR may not always be a good indicator of nutritional status. Improvement in health care can bring about a significant alteration in IMR without any marked changes in nutritional status during infancy. It is, therefore, obvious that only under specific circumstances where IMR and under-nutrition coexist, the former can be used as a possible indicator of trends in nutritional status.

CHILDHOOD MORTALITY RATES

Under-nutrition and high mortality rates during childhood exist in poorer segments of the population in several developing countries. However, the association is most likely to be mediated through poverty, poor environmental hygiene, high morbidity rates and lack of medical facilities. It is possible that improvement in medical facilities might result in marked reduction in childhood mortality rates without any alteration in nutritional status of the individual as assessed by anthropometric indices. In fact, this is apparently the situation in Indonesia, Malaysia and Sri Lanka where substantial reductions in infant and childhood mortality rates have been observed in the last two decades. It is possible that no perceptible improvement in the nutritional status of children occurred during this period. It is also possible that because of improved medical care even severely undernourished children survived and because of their survival there was no alteration in the proportion of children showing varying grades of under-nutrition. It is possible that both these phenomena might exist together. Whatever might be the reason, data from developing countries clearly demonstrate that substantial alterations in infant and childhood mortality rates could occur with insignificant changes in nutritional status as assessed by anthropometric indices.

ECONOMIC PARAMETERS

Socio-economic variables have been widely used as indicators of nutritional status because in most communities poverty is the major factor responsible for under-nutrition. The use of socio-economic parameters

for assessment of nutritional status is being reviewed elsewhere. Therefore, only a brief mention of the problems in using information on economic status as an index of nutritional status is made. Gross national product (GNP) and average per capita income (PCI) have been widely used for classifying nations or regions in different countries from the point of view of nutritional vulnerability. These indices do provide some indication regarding nutritional vulnerability. For instance, it is logical to conclude that the USA with an average PCI of over $1000 per month is unlikely to have under-nutrition as a national public health problem. However, a high GNP and a high average PCI do mask the fact that even in the USA some segments of the population suffer from socio-economic deprivation and under-nutrition.

Among developing countries GNP and PCI do provide a readily available method of evaluating nutritional vulnerability. However, it is possible that the pattern of distribution of income between different segments of population might vary widely between countries with the same level of GNP or PCI. It has been reported that because of a more equitable distribution of income and administrative measures to ensure that the minimum needs of individuals are met, the nutritional status of the Chinese is much better than that of nationals of several other countries with about the same GNP or PCI.

Factors other than economic status do determine the nutritional status of a community. Though the PCI may not be significantly different between two states, better utilization of all available resources including health care, could result in significant differences in nutritional status. The oft quoted example in the Indian subcontinent is the relative rarity of severe grades of malnutrition in Kerala as compared to Uttar Pradesh.

Even within a state there might be marked regional differences. For example, the PCI of Maharashtra state is high mainly because of the high PCI of Bombay city dwellers. However, the PCI of the Marathwada region might not be higher than that of the neighbouring states.

Even at an individual level, PCI might not provide a readily useful index of nutritional status. An unskilled dock labourer might earn as much as an M.Sc., but there are bound to be major differences in the expenditure pattern and nutritional status of the two families. Thus, though economic status provides a rough and ready method for assessment of nutritional vulnerability of countries, communities or individuals, this indicator needs to be used with caution.

SUMMARY AND CONCLUSIONS

It is obvious that at the moment there is no single universally applicable index for assessment of nutritional status; nor is it likely that such

an index will be developed in the foreseeable future. However, we do have a variety of parameters which are of some use in assessing nutritional status. If information on as many of these indices as possible is carefully collected, correlated and interpreted, it is possible to paint a composite comprehensive picture of the nutritional status of the individuals, community or country. Often, there are numerous difficulties which come in the way of conducting such well-planned and executed studies. Even under these adverse circumstances it is possible to obtain reasonably accurate information on the nutritional status by a judicious choice of parameters to be used for the evaluation, taking into consideration the rationale of the survey, the time available and the tools at one's disposal.

3B The Use of Socio-economic and Mortality Data to Assess Nutritional Status

KAMALA GOPAL RAO

UNICEF has advocated nutrition as one of the crucial components of basic services geared to the needs of the young child. Reinforced by experience, nutrition has been promoted in the overall context of primary health care and in conjunction with other preventive health measures like immunization, improved midwifery, safe water, sanitation etc. More recently, through the State of the World's Children Reports, UNICEF had advocated four low-cost interventions for child survival and development—growth monitoring, oral rehydration for diarrhoea, immunization and breast-feeding, and had subsequently shared the positive global experience of their implementation and effectiveness. In Indonesia, around 2.5 million growth charts are being filled up by mothers either alone or with the help of health workers. The 'Growth Chart' is but one of the measures for identifying growth faltering, a sign of invisible malnutrition. There is an urgent need to devise other locally relevant measures for growth monitoring. It is also recognized that malnutrition is caused by infections. The relative importance of these two causes is far less crucial than the sinister synergism between them.

USE OF MORTALITY DATA TO ASSESS NUTRITIONAL STATUS

Nutritional status depends upon several factors and the causal relationship between malnutrition, mortality, morbidity and health are complex. Malnutrition could be an aggravating or mediating cause of mortality rather than a direct one.

Even the study of cause-effect relationship between feeding interventions and weight gain is not infallible. In poor homes, supplementation is shared by all family members. The studies in the forties in Leningrad, Holland and Wuppertal have proved that it is only in conditions of acute and continued starvation that there is a linear relationship between food intake and body weight.

Apart from the lack of identifiable relationships between factors affecting nutritional status, there are basic deficiencies in the data themselves in terms of availability, range, reliability, recency, disaggregation, specificity and sensitivity. In a survey of Infant and Child Mortality, information on 10 important causes of infant and child deaths had limited reliability, based as they were on the perception of lay respondents in the absence of diagnosis by a trained physician. The proportion of deaths for which cause was not reported ranged from 22 per cent in Uttar Pradesh to 60 per cent in Kerala. This mortality data could only be used as indirect or additional indicators of nutritional status, and not as a substitute for direct measurements.

USE OF SOCIO-ECONOMIC PARAMETERS TO ASSESS NUTRITIONAL STATUS

Dr Prema Ramachandran's paper suggests the use of gross national product and per capita income as economic indicators for assessing nutritional status. However, this relationship is complex. Poverty is not an exclusively economic problem although predominantly so. Also, GNP and PCI are not the most sensitive measures of poverty at the household level and its consequences for nutritional status. Furthermore, the poor are not a homogeneous group.

However, the poverty-nutrition relationship is more clear-cut when the following are considered:

i. Poverty line is defined in terms of calorie intake and the converted income figures. The justification appears to be that poverty directly affects calorie adequacy. Consumer expenditure figures in 1971–72 showed that 52 per cent of the rural households below the poverty line were deficient in calories compared to 8 per cent of those above the poverty line. The poorest 40 per cent of the rural population spend over 80 per cent of their income on food compared to 47 per cent spent on food by the rest of the population. These figures underscore the importance of availability and prices of food for the poor.
ii. Seasonality aggravates both poverty and malnutrition. Some of the studies and analyses by Robert Chambers amply bear out this statement.

The following are suggested as points for further discussion:

i. The use of morbidity indicators for assessing nutritional status, such as the prevalence of weaning diarrhoea, percentage of children and women (especially pregnant women) who are anaemic, and proportion of children in the population experiencing frequent diarrhoeal episodes.
ii. The need to consider social objectives rather than merely the health outcome indicators like mortality and morbidity. It is the objective of a nutrition programme that determines what indicator needs to be used; for instance the Special Nutrition Programme (SNP), Integrated

Child Development Services (ICDS) and Midday Meal Programme are all feeding interventions but their objectives are quite different. In the midday meal programme school attendance would be more important, while in the ICDS, the indicator would be the percentage of children 0 to 3 and 3 to 6 years who move from the third degree of malnutrition to the second. For some intervention programmes where outcome indicators like better nutritional status take a long time to surface, one has to look for intermediate indicators to measure the immediate objectives such as reach, coverage, convergent service delivery, infrastructure or management. These indicators would include number of workers in position, number of workers trained, proportion of target population covered etc.

iiii. The need for developing more sensitive indicators for survival and development. How relevant is nutrition for both? How can nutritional status be used as a predictor of mortality and morbidity? What are the indicators for acute and chronic malnutrition, for under-nutrition and malnutrition? Other indirect indicators are maternal education and maternal income which are found to affect food consumption in the family as well as nutritional status.

iv. The need to develop appropriate technology and simple indicators to enable and equip mothers to monitor child growth and identify early warning signs of malnutrition.

4 Non-Invasive Parameters for Field Monitoring and Evaluation: their Sensitivity, Specificity and Cost

M. C. SWAMINATHAN

The term monitoring signifies a 'close watch' on the various components of a system or programme. Evaluation involves assessment of the effectiveness of the system in relation to its goals and objectives, and invariably includes an analysis of the data collected from the monitoring system. In many instances the monitoring system along with certain parameters of evaluation could be used for periodic evaluation of the system. Thus monitoring and evaluation are interdependent. This concept of 'surveillance' applied to the field of nutrition would mean that the objectives of monitoring and evaluation are mainly:

(a) To assess the trends in nutritional status or implementation of the programme.

(b) To assess the impact of effectiveness of the relevant programme in terms of certain parameters which reflect the objectives. Even if the final objective or goal is not achieved over the specified period of time, an assessment of the trends or direction of changes in the parameters helps us in planning for the future. These assessments could be done for individuals but are more commonly adopted for groups of subjects. They may utilize direct or indirect methods and the types of information or data collected depend on many factors.

The various types of information or data collected for monitoring and evaluation in nutrition are:

i. Mortality
ii. Morbidity—both non-nutritional and nutritional, i.e. prevalence of common diseases
iii. Anthropometry
iv. Dietary intake
v. Indicators of social and psychological development, quality of life, attitude of the community

The methodology of collecting the information involves both direct and indirect approaches. The information could be had directly from the beneficiaries and the community and/or from existing records specially meant for the study of nutrition. Direct examination of the beneficiaries and the community for assessment of the nutritional and health status is invariably included, the target groups varying according to the needs of the study. Statistical consideration in regard to the selection of the sample and, where necessary, the control group or unexposed group for comparison particularly in cross-sectional studies is given adequate importance. The period of observation for assessment varies according to the type of study and is usually determined on the basis of previous experience.

The basic criteria involved in selection of the parameters for monitoring and evaluation in nutrition are:

i. *Specificity*—The extent to which the selected parameters specifically identify nutritional status.
ii. *Sensitivity*—The capacity of responding to minor changes attributable to nutrition.
iii. *Simplicity*—In effect the need for the minimum of skill, time and organization as well as feasibility under the conditions of the study.
iv. *Economy*—Involving the least cost and thus obviously including a consideration of aspects of skill, time and organization.

The relative values of the various parameters normally used in studies on monitoring and evaluation in nutrition are given in Table 1.

Patterns of mortality and morbidity are very poor in both specificity and sensitivity, as are the social and psychological aspects of nutrition. These are conditioned by external and environmental factors which have a bearing on nutritional status. Usually parameters of clinical nutritional status, anthropometry and dietary intake are relatively more specific and also sensitive enough for purposes of monitoring and evaluation. However, their relative values vary. If they are used in combination, they give a better assessment in comparison with the use of a single parameter. Experience has shown that for short-term assessments, clinical indicators are most useful and sensitive particularly where the nutritional disorders are widely prevalent. It is apparent that anthropometry is relatively simple as the skill involved can be transferred easily to others and the time taken is much less. Though errors of measurement such as those of the observer, mechanical defects, inaccurate recording or computational errors do occur, it is more objective than the other indicators and least expensive. Therefore, in any study of monitoring and evaluation of nutritional status or programmes, assessment of clinical status, anthropometry and dietary intake usually find a place. Table 2 gives the methodology or the parameters used in some of the evaluation studies carried out in India. These confirm the values of clinical

TABLE 1

Relative Values of Parameters

	Specificity	*Sensitivity*	*Simplicity*					
			Skill	*Time*	*Organi-zation*	*Cost*	*Errors*	*Overall Rank*
Mortality	Poor	Poor	Less	Less	Less	Low	More	IV
Morbidity								
Non-nutrition	Poor	Poor	More	More	More	High	Less	V
Nutrition	Good	Good	More	More	More	High	Less	I
Anthropometry	Fair	Fair	More	Less	Less	Low	Less	II
Dietary Intake	Fair	Fair	More	More	More	High	More	III
Social and Psychological Measurements	Poor	Poor	More	More	More	High	More	VI

TABLE 2

Evaluation of Nutrition Programmes

Programme	*Adminis-tration*	*Morbidity/ Mortality*	*Anthropometry*				*Hb*	*Clinical*	*Diet*	*Nutri-tion Educa-tion*	*Health & Family Welfare Services*	*Attitudes*	
			Ht	*Wt*	*MUAC*	*FFT*						*Function-aries*	*Com-munity*
1. Special Nutrition Programme Karnataka (Rural & Urban slums) (1980)	—	×	×	√	×	×	√	√	√	×	√	√	√
2. India Population Project Karnataka (Rural) (1981)	—	√	√	√	√	√	√	√	√	√	√	√	√
3. Applied Nutrition Programme Six States (Rural) by NIRD (1978)	—	×	×	×	×	×	×	×	×	√	×	√	√
4. WFP-SNP Nine States (Rural & Urban slums) (1983)	√	—	—	√	√	—	—	√	—	—	—	—	—
5. Vitamin A Prophylaxis Programme (Rural)	—	—	—	—	—	—	—	√	—	—	—	√	√
6. Midday Meal Programme in:	—	—	√	√	—	—	—	—	√	—	—	√	√
(a) MP (CARE)													
(b) Orissa													
7. ICDS (1982)													
(a) AIIMS	—	—	—	√	—	—	—	—	—	—	—	—	—
(b) PEO	√	—	—	—	—	—	—	—	—	—	—	—	—
8. NNMB	√	×	√	√	√	√	—	√	√	—	×	×	×

√: Parameters used; × : Parameters not used;—: No information available.

signs, body weight and mid-upper-arm-circumference (MUAC) for such studies. Wherever feasible, other parameters indicative of nutritional status are included in a limited manner but their usefulness has not been sufficiently demonstrated.

Under anthropometry a variety of measurements (Table 3) have been utilized for monitoring and evaluation. But the experience gathered over the years has clearly shown that body weight is still the most ideal measure for the assessment of nutritional status. Studies have shown that mid-upper-arm-circumference measurement could be used on groups of subjects rather than for assessment of individuals. Next to body weight it would seem that measurement of MUAC with all its limitations could be used under field conditions. However, the choice of the method of measurement depends on the objective of the study. One simple principle that can be adopted is to select those measurements needing skills which can be easily transmitted to the personnel in the field. From that point of view simple measurements like body weight which is very objective and MUAC are very useful. Relatively speaking, errors in these measurements are likely to be much lower than in the other measurements (Table 3). In a recent study conducted among community health volunteers, it was concluded that CHVs could be utilized for monitoring and evaluation of nutrition in a rural community. Weight-for-height (leanness chart) and MUAC (tricolour tape) are used for the purpose. With proper training weight-for-age, height-for-age and growth charts could also be used by CHVs.

The degree of agreement in observations of trained workers and CHVs is high in all the measurements. It seems to vary with the grade of under-nutrition. In this respect weight-for-age and MUAC seem to be better since the similarity between grades is very close in both these measurements (Table 4).

Various types of indices based on measurements of weight, height etc. have been suggested for use by research workers. So far, these have not been extensively utilized and tested to facilitate any reasonable conclusions. Since a number of parameters are utilized by various types of personnel in the assessment of nutrition for monitoring and evaluation in the field, there is obviously a need for standardization of the techniques to avoid or limit the errors involved. These errors are due to investigators, recording procedures and mechanical problems. Standardization is relatively easier in anthropometry but for other techniques it is more difficult. Therefore, care should be taken to estimate the errors involved in the use of these parameters before the study is undertaken so that a proper interpretation of the results can be made. Pre-testing in a pilot area and intense training for the investigators are the usual methods for the purpose.

TABLE 3

Relative Values of Physical Measurements

	Specificity	*Sensitivity*	*Simplicity*					
			Skill	*Time*	*Organi-zation*	*Cost*	*Errors*	*Overall Value*
Weight	Good	Good	Less	Less	Less	Low	Less	I
Height	Fair	Fair	More	More	More	Low	More	III
Mid-upper-arm-circumference	Fair	Fair	Less	Less	Less	Low	Less	II
Skin Fat Fold	Poor	Poor	High	High	High	Low	High	IV

TABLE 4

Degree of Agreement Between Trained Workers and CHVs

	Grades				
	I	*II*	*III*	*IV*	*All Grades*
Height-for-age	82.0	83.7	77.9	67.0	78.6
Weight-for-age	74.8	82.4	80.3	75.0	80.6
Weight-for-height	97.9	80.7	—	60.0	91.7
Mid-upper-arm-circumference					
—Tape	88.6	80.5	—	84.1	85.4
—Bangle	65.3	83.8	—	88.9	80.6

In monitoring and evaluation, the cost of assessment is very important. The exact cost of each parameter or technique estimated in terms of the amount required per person or per beneficiary can be assessed under controlled conditions in a research study. But this is likely to vary under different field conditions and so a standard figure will not be available. More important are qualitative estimates of the relative cost of various techniques adopted for the assessment. The cost depends on the type of personnel, number of subjects, distance or area covered, transportation and other material costs. The more skilled the personnel and the more refined the techniques, the greater will be the cost. It should be emphasized that cost alone should not be the criterion for the selection of parameters. The objective of the programme and the available information on the system of monitoring as well as the specificity and sensitivity of the indicator should be given more importance.

5 Invasive Parameters, Biological Specimens, their Sensitivitiy, Specificity and Cost

K. VIJAYARAGHAVAN,
MRUNALINI PUAR, SUNDER GUJRAL &
U. V. MANI

The assessment of nutritional status can be done using clinical, anthropometric, biochemical and biophysical parameters. These laboratory methods evaluate certain biochemical functions which are dependent on an adequate supply of essential nutrients.

The use of laboratory tests has two primary functions:

(a) To detect marginal nutritional deficiency in individuals particularly when dietary histories or questionnaires do not provide adequate information or when dietary histories are of a questionable nature. As biochemical changes usually precede the appearance of overt clinical signs of disease, they are especially important. As such, appropriate remedial steps can be initiated quite early.

(b) To supplement or enhance other studies such as dietary histories, clinical assessment or anthropometry.

All biochemical estimations have certain limitations. Although various body tissues are available for biochemical estimations, we normally depend on two body fluids, blood and urine. At least one blood sample should be collected for analysis. In case of pre-school children, sometimes even a single sample is difficult to get. If the biochemical tests require two samples, it is almost impossible to get them. In young children, one just cannot draw samples of intravenous blood. Thus, fingertip methods need to be developed.

The ideal criteria for biochemical tests have been defined by Whitehead. He stresses that the samples should be easily collectable, should be stable during transportation and should be unaffected by recent meals. Moreover, information obtained from biochemical analysis should not be already available from non-biochemical techniques so that this can be used for objective assessment or for screening purposes.

The parameters should be both specific and sensitive. Sensitivity is the ability of the test to pick out the actual positives, while specificity is its ability to pick out the actual negatives. For instance, in case of anaemia, the sensitivity of a test is its ability to identify all anaemic subjects while its specificity is its ability to pick out the non-anaemic subjects. It is difficult to get both specificity and sensitivity of a very high order in a particular parameter. If the product of sensitivity and specificity is about 0.8, the test is considered to be good.

The common nutritional disorders in the country are Protein Energy Malnutrition (PEM), Vitamin A deficiency and iron deficiency anaemia. In case of PEM, the most consistently confirmed biochemical abnormality, especially in children with kwashiorkor, is lower serum albumin level. But it is generally agreed that the body's ability to synthesize serum albumin is affected relatively little by growth. As a result, the level of serum albumin falls significantly only in severe protein deficiency. Thus, serum albumin most often serves as a confirmation of a condition already clinically very evident. Most workers agree that it does not have much value for detecting marginal and mild to moderate cases, making it neither specific nor sensitive for PEM.

Other biochemical parameters such as amino acid ratio are not feasible and cannot even be considered under field conditions. Whitehead stresses that one should take a look at serum albumin levels. His argument is that hypoalbuminaemia can develop into growth retardation and perhaps one can use serum albumin levels as an indicator of susceptibility of a child to develop oedema.

In spite of the enormous advance in the field of nutritional biochemistry, no new test is yet available which can be used in field surveys as an indicator for PEM. Nevertheless, one can use these biochemical parameters along with a clinical or anthropometric assessment to reasonably evaluate the protein-energy nutritional status.

The basic difficulty in identifying Vitamin A deficiency is that the function of Vitamin A, except in the case of vision, still remains obscure. At present, there is no readily determined biochemical measurement of derangement due to Vitamin A deficiency.

Since the liver is the major storage organ of Vitamin A in the body, the concentration of retinol and its esters in liver tissue can be considered as a direct measurement of Vitamin A disorders. However, this requires liver biopsy which is not feasible in field conditions. Another disadvantage of measuring liver Vitamin A is that it does not indicate the amount of Vitamin A available to the peripheral parts. The plasma levels of Vitamin A reflect the florid status only under two very different circumstances; first, when the liver stores have largely been depleted; and secondly, when the liver is saturated with Vitamin A as in hypervitaminosis. However, one can still use these methods not at

individual levels but for community assessment by preparing plasma Vitamin A distribution graphs for populations. The use of these graphs depends on the assumption that the primary cause of the curve being shifted to the left is inadequate Vitamin A.

The cut-off points suggested by WHO for using plasma Vitamin A levels are:

< 10 mcg/100 ml—deficient
10–20 mcg/100 ml—low
20–50 mcg/100 ml—medium
> 50 mcg/100 ml—adequate

One must be careful while interpreting low level values as they may also be associated with inadequate protein intake, parasitic infection, liver disorders etc.

Some investigators in the field of Vitamin A deficiency have proposed that plasma retinol binding protein (RBP) can be used as a parameter. However, the total RBP requires specialized instruments which are not feasible for use in the field.

Unlike PEM and Vitamin A deficiency, clinical signs in anaemia are considered rather subjective and are useful only in severe cases. Therefore, one has to resort to haemoglobinometry or packed cell volume (PCV), both considered to be relatively error-free and often used as diagnostic tools. The only drawback is that haemoglobin estimation alone is not conclusive in the detection of iron deficiency but is useful in overall diagnosis.

Under field conditions haemoglobin is estimated by the filter paper technique. Here, a measured amount of blood is delivered on a filter paper and estimation is done at a later date. The method was originally developed by workers from Thailand. Further studies in our country, however, have shown that values obtained by the filter paper method are consistently lower than those obtained by the direct method. The difference is about 9%. Therefore, this small correction factor can be applied whenever the filter paper technique is used.

In conclusion, the selection of biochemical criteria depends on the purpose of the survey. Among the routine surveys, only haemoglobin estimation appears to be a relevant and reliable biochemical parameter. In fact, of the several biochemical parameters, WHO in its technical reports on nutritional surveillance recommends only haemoglobin for the assessment of nutritional status and suggests that other examinations be used only for follow-up purposes.

BIOLOGICAL SPECIMENS

In recent years, nutritional surveys have seldom been conducted without the inclusion of some kind of biochemical estimations. This is

so because these tests represent the most objective assessment of the nutritional status of an individual, frequently providing sub-clinical information.

In order to determine nutritional status on a large scale, an important consideration is the knowledge of the type of sample available for assay. The biological material should truly and accurately reflect the dietary history of the individual being surveyed, yet it must be easily obtainable. For this reason, biological specimen collection is usually limited in the field to blood, urine and faeces. While any of these measurements can usually be accomplished very easily, one must keep in mind that concentrations of nutrients in blood reflect to a large degree the previous meal or day-dietary intake. The use of fasting subjects will, however, correct some of the fluctuations of nutrients in the blood which result from recent food intake.

Concerning the feasibility of using urine as a nutritional assay sample, one must consider the sample size. Does one attempt to collect a 24-hour sample which is extremely difficult in a free-living population? Or would the first voided morning urine specimen which can be more easily obtained be adequate? Or, finally, would a randomly voided sample be acceptable?

Ideally the 24-hour urine sample would provide the most accurate estimate of the amount of nutrient, metabolite or element. However, some of the disadvantages of the 24-hour urine collection technique in the general population are:

i. It is physically difficult for people to make such collections when they are away from home.
ii. Difficulties in collection from adults are largely related to modesty. 24-hour collection from young children also poses much difficulty. Besides, it is difficult to assess the completenesss of the 24-hour collection since a portion of the specimen might easily have been missed.

The other extreme in contrast to a 24-hour specimen would be the collection of random urine samples. Obvious problems with this type of specimen include size of sample, physical activity and liquid consumption prior to collection, and the time when the collection was made. All these factors will markedly affect the concentration of the nutrient, metabolite or element in the urine. Between the two extremes would be an overnight or first voided morning urine specimen. This type of sample would have some merit as it would tend to standardize physical activity and liquid consumption during the collection. Hence we see that the problem of obtaining a useful and reliable urine volume sample with attempts to determine nutritional status on a large number of persons under survey type conditions is still not completely solved.

The discussion of biological specimens for nutritional field evaluation would not be complete without a brief consideration of some human biological materials which are currently on the horizon. One such material which has shown great potential, at least for the determination of trace element and protein status, is the use of hair as a biological sample. One of the advantages of using hair as biopsy material, should it prove successful, is the ease with which such a sample could be obtained. Perhaps an even greater advantage would be that hair by its very nature would reflect the longer-term nutritional status rather than recent dietary intake. Growth rate, morphology and colour of hair reportedly respond to inadequate protein levels in the diet. General conclusions from studies reported in the literature with the specific purpose of determining the value of hair as an effective biopsy sample for zinc were that hair zinc varied with age, did not vary with sex, but was decreased in pregnancy and lactation and should be used to compare nutriture of individuals or groups only on an age-matched basis. From copper studies it was concluded that hair copper varied both with age and sex, was correlated with plasma copper and should be used as a nutriture comparative only on a sex- and age-matched basis. Consequently, the mineral content of hair has been proposed as an index of chronic status of trace element nutrition. One of the questions raised concerning the use of hair as biopsy material was whether trace elements were absorbed on the hair filament from environmental contamination such as sweat. Radioisotopic studies indicated that minerals were absorbed on previously washed hair which did not contain natural oils. Apparently this matter protects the hair from contamination. Since the use of hair as a biological specimen for determining nutritional status is still in its exploratory stage, much more work is required before it can be accepted as biological material for nutriture determination and before normal ranges can be set.

Fingernails also represent another readily accessible tissue. They may also serve as effective biopsy material for determining nutritional status with respect to certain nutrients. But currently, very little data are available concerning normal values. Hence its application in the assessment of nutritional status in field studies has not yet been looked into.

The absence of suitable parameters for detecting marginal changes, especially in mineral status, in man has led to the investigation of saliva as a diagnostic tool. Today, saliva has not been thought of as useful in evaluating mineral status mainly because of the variability in its fluid content and dependence on hydration of the subject. Hence, in summary one can say that although there are a number of biological materials available for assessing nutritional status in a human population, generally in field surveys one is restricted to measuring the concentration of

a particular nutrient which is either excreted in the urine or faeces or circulated in the vascular system. Recently hair, nail and saliva have been suggested as being perhaps appropriate as biological specimens for determining nutritional status with respect to a particular nutrient. However, much work in this area still needs to be done.

COLLECTION AND TRANSPORTATION OF BIOLOGICAL MATERIALS

Feasibility of collection and ease of transportation of biological materials are two factors that impose a constraint on the biological parameters that one can use in field studies. Biological material, whether blood, urine or faeces, is difficult to collect during field investigations.

Some of the problems encountered in collection and transportation of blood samples are:

i. Non-cooperation and unwillingness of the subjects especially during collection of blood samples. In many cases, subjects refuse to give venous blood for estimations.

   It is necessary that the investigator explains to the subjects the importance of the samples being collected.

ii. Non-availability of the subject for collection of timed samples.

iii. Social and cultural constraints on blood collection, particularly in tribals.

iv. Non-availability of skilled help at the site of blood collection.

v. Carrying all the equipment in the required numbers, especially during blood collection, sometimes poses a problem.

vi. Maintaining cleanliness and avoiding contamination which would otherwise cause spoilage of samples.

vii. Smudging of labels during transportation if the containers are not covered with cellophane etc.

viii. In case of parameters, e.g. glucose and lactic acid, that need to be analysed soon after collection of the sample, it becomes difficult if the site of collection is far away from the laboratory.

ix. If the mode of transport is not convenient, there might be breakage of containers. It is also important to maintain optimum temperature during transportation.

The above-mentioned points suggest that perhaps biochemical parameters are less suitable for field-oriented studies unless micro-methods and portable equipment are used.

PORTABLE EQUIPMENT FOR BIOCHEMICAL ANALYSIS

As mentioned earlier, collection and transportation of biological samples in field conditions pose a number of problems. These can, to a certain extent, be overcome by using mobile laboratories consisting of

manually operated accessories. However, this will not be feasible if the sample size is too small and if the area to be covered is not motorable.

In recent years, several instrument manufacturing companies and other institutions have produced certain portable instruments which are battery operated, quite compact and can easily be carried to the field. For example, J. Mitra & Sons, New Delhi supplies reflectance colorimeters which are specific for a particular estimation. Miles India Ltd., Baroda makes dextrometers which can quantitatively estimate blood glucose by a fingerprick technique.

Nowadays, it is more feasible to look for micro-techniques where micro-quantities of a sample can be used. A few years ago all biochemical tests, e.g. detection of amino acids or urea, needed about 200-300 μl of a sample for complete analysis. Today, however, the same estimation can be carried out using nanogram or even picogram amounts of the sample. But such micro-techniques involve sophisticated instruments which makes them non-feasible for use in the field. Techniques like High Performance Liquid Chromatography are faster, more sensitive and reliable and are gaining importance in the laboratory.

There are ways of solving some of the problems but they depend to a large extent on budgetary provisions. If these biomedical reagents and instruments can be used, the analysis of biological specimens in the field should be easier than what it was a few years ago.

SUMMARY OF COMMENTS BY PARTICIPANTS

Anthropometry coupled with clinical examination for symptoms of specific deficiencies appears to be the most acceptable set of indicators for assessing the nutritional status of individuals as well as for groups of children. The nutritional status profile of young children appears to be a fair indicator of the general well-being of the community. It can also provide a basis for child-related, family-related and community-related action. However, anthropometry has its limitations. It is based on its assumed relationship to individual well-being and there could be considerable difference of opinion on this point. Expert opinions often differ regarding the comparative usefulness of different anthropometric measures. Weight-for-age and weight-for-height have generally come to be accepted as measures of high reliability. Yet there are serious doubts when a rigid value is sought to be followed as a standard. This problem is generally resolved by adopting standards composed of ranges of values or growth trends. Yet when you go into details you are faced with questions as to the kinds of weighing scales and measuring rods and growth cards to be used. Dietary intake as a measure also has its limitations. Requirements of nutrients are still based on a rather incomplete understanding of their physiological functions. Moreover,

studies on dietary intake face many practical problems in their execution. Yet they do provide some useful information which, along with information from other sources. can be of use.

Reference can also be made to the physical quality of life index. We are gradually becoming aware of the limitations of this index as based on infant mortality, expectancy of life or total mortality, and literacy rates. On the present formulation of this index, if one were to look at Sri Lanka, it indicates a very high level of physical quality of life for its people. Kerala in our country is another example. But if one examines the situation more closely, one finds that even in Sri Lanka during the last seven years the incidence of malnutrition in young children, in the age group of 12 to 60 months, has steadily increased. Kerala too has a fair level of malnutrition in this age group. Early childhood nutrition status is generally accepted as a fair index of the general well-being of the society. Therefore, childhood nutrition status should obviously be incorporated into the physical quality of life if we are to use this as a valid measure of the general well-being of a community.

However, with an understanding of all the advantages and limitations of the measures of nutritional status, these measures can be effectively used to define the problem, to formulate policy and to evaluate programmes. If the information collected through these measures is integrated with information from other sectors, then they serve a much wider function in a much wider perspective.

The concept of 'at risk' has great potential for application. Its use has so far been very limited in nutritional monitoring and assessment. It is not enough to use this concept based on some sophisticated measures in a few projects. Consider the difference in perspective of individuals, scientists, social workers and people from public systems or government. An individual scientist may find fulfilment in doing some excellent work in one minute branch of knowledge; an individual social worker may achieve fulfilment in doing extremely good work in a village or in a group of 5 to 6 villages or may be in a block; but no government can find fulfilment or can even subsist by doing some excellent work in one or two areas. Governments have to find out methods and activities which are of large-scale application. It is not that quality is sacrificed for quantity. But even if one were to stress the argument that quality is being sacrificed, the government can never be satisfied unless it can do something for a very large number of people. There has been some progress in developing 'at risk' indicators for vulnerable groups like children, pregnant and nursing mothers. But often the set of 'at risk' indicators imposes some measures that cannot be easily applied in the context of village level workers with modest training.

As regards households, the development of acceptable and easily applicable measures for defining households which are nutritionally at

risk has been almost negligible. Even in the ICDS programme, though there are guidelines on this, the use of the 'at risk' concept is still very limited. Much more needs to be done in this area.

Nutritional monitoring and assessment, broadly speaking, should serve the purpose of long-term planning, programme management and evaluation, and timely working and intervention to prevent and manage emergencies. And in India, in some sectors, a great deal of information is flowing. In fact, agricultural data in this country are extremely comprehensive. What is known in Gujarat as 'anewali' or an assessment of the crop yields while the crop is still growing, gives you well in time a very good assessment of what is going to be the nutritional impact on the population of the expected crop yields long before the crops are actually harvested. And this enables the government to take action well in time. It enables the government to move food from one place to another, to start public works, and to provide employment so that people can earn something to buy food.

The National Nutrition Monitoring Bureau (NNMB) located at the National Institute of Nutrition (NIN) conducts annual sample surveys on food consumption and child nutrition. We have the National Sample Surveys (NSS) too. While these give some indication of the nutritional situation in the country, or for different segments of population in the country, there are several other information systems that are being followed in different programmes. Consider, for example, ICDS, a major programme. Information is collected through various sources apart from the usual reports that come in from the projects every month. Annual sample surveys on the health and nutritional status of children and mothers in the project areas are conducted with the help of some medical colleges. And these are reinforced by observations of people who visit these projects.

The earlier approach to nutrition was dominated by one or another dimension such as physiological well-being of individuals, social and economic dimensions of nutrition and human resources development, which underline the importance of nutrition particularly in early childhood, and during pregnancy and lactation. However, a more holistic approach to nutrition is now developing.

6 Process Evaluation—A New and Important Concept: Case Studies to Exemplify

TARA GOPALDAS

The concept of process evaluation is something new. About ten years ago, when Project Poshak was undertaken, this term was not much known. The evaluation model of Project Poshak was essentially a process evaluation model. I will illustrate process evaluation with three sub-models. The first is Project Poshak, the second is our attempt at feeding nutrients and de-worming inputs to primary school-age children, and the third is a prospective one—the evaluation of the National Nutritional Anaemia Prophylaxis Programme.

IMPORTANCE OF THE CONCEPT

i. The concept is of value as it provides for the inclusion of a number of sequential stages or elements in an entire nutrition programme or project which, interacting with each other, form or make up a total delivery and impact system.
ii. The setting up of such a conceptual model for a nutrition programme aids the evaluator in viewing the entire system in perspective.
iii. Such a model assists the evaluating team in setting up formats for the collection of data and for each sequential stage.
iv. Data collected on the basis of such conceptual models greatly facilitate the smooth two-way flow of information, as is essential in a Management Information System.
v. Working with such models is cost-effective as evaluation of the operational or administrative sequential stages could be a useful indicator as to whether the more expensive impact evaluation should at all be undertaken.

I shall try and attempt to exemplify the above using three schematic process evaluation models. These are as follows:

A. Model used in Project Poshak[1]
B. Model used in a study delivering nutrient and de-worming inputs to Midday Meal Programme (MDM) beneficiaries[2,3,4]

v. Significant improvement in the educational scores of mothers in the experimental *vis-à-vis* the control group.
vi. Significant improvement in the dietary intake of the experimental *vis-a-vis* the control group. The extent to which the 'take-home' food was a substitute/supplement to the basal diet of the experimental group of children.

The impact evaluation criteria for the mother beneficiary were as follows:

i. Birth weight of new-borns of experimental group of mothers *vis-a-vis* that of new-borns of control group.
ii. Extent of participation in programme.
iii. Extent to which 'take-home' food was a supplement/substitute to basal diet; extent of sharing by other family members.
iv. Significant reduction in clinical signs in experimental compared to that in control group.
v. Significant reduction in morbidity episodes in experimental compared to that in control group.
vi. Significant improvement in awareness of nutrition-health concepts in experimental *vis-a-vis* control group.

B. Process Evaluation Model used in the MDM Study

This study included the delivery of nutrient-health inputs to MDM and non-MDM schoolchildren. The process evaluation model used in the MDM study is illustrated in Fig. 2.

The sequential stages were as follows:

i. The efficiency and feasibility of delivery of the three inputs of anthelminthic drugs, mega Vitamin A syrup and iron folate tablets by the investigator to the target group, i.e. schoolchildren.
ii. The efficiency of receipt of the above-mentioned three inputs by the schoolchildren.
iii. The impact of these inputs on the nutritional health status of the schoolchildren.

The operational parameters were defined as follows:

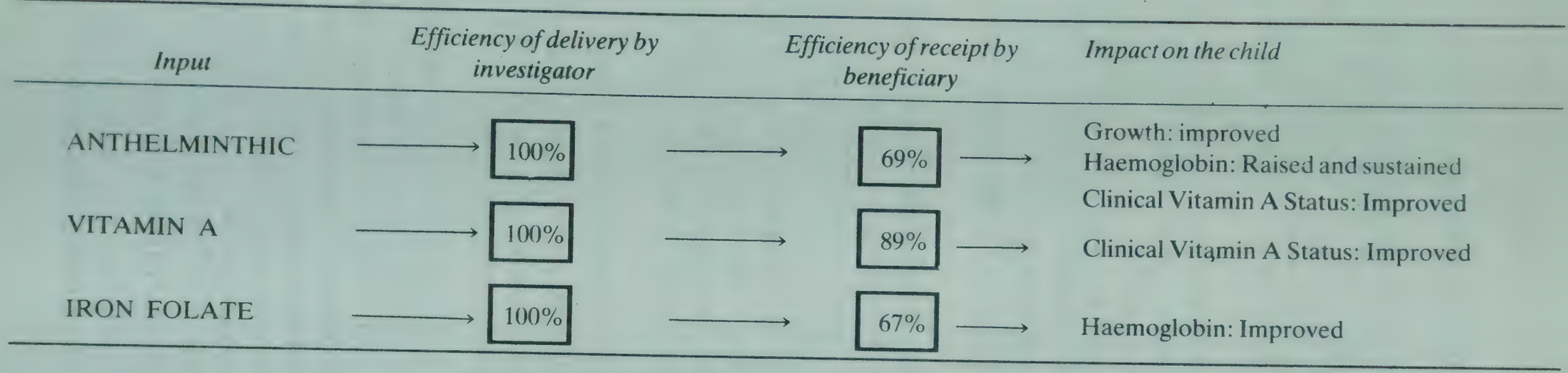
i. Efficiency of delivery of inputs by the investigator was indicated by the number of days in which the inputs could be delivered to children expressed as a percentage of the targeted number of intervention days.
ii. Efficiency of receipt of inputs was indicated by the extent to which the inputs were received by the children (measured as a percentage of the target dose) as determined by their school attendance.
iii. Feasibility of delivery of tablets was determined by subject compliance in receiving the inputs.

The impact evaluation criteria were as follows:

i. Significant increase in percentage of subjects who improved their

FIGURE 2

The Process Evaluation Model used in the Study on the Delivery of Nutrient-Health-Inputs to MDM Beneficiaries



weight-for-height after intervention: experimental *vis-à-vis* control group.

ii. Significant increase in haemoglobin levels in each experimental group compared to (a) its own baseline, (b) the control group.

iii. Significant reduction in prevalence of signs and symptoms of Vitamin A deficiency in experimental *vis-à-vis* control group.
   (a) Presence of night blindness, conjunctival xerosis and/or Bitot's spots.
   (b) Vitamin A responsive cases, i.e. those with night blindness and conjunctival lesions (xerosis and/or Bitot's spots) responding to Vitamin A administration.

iv. Significant reduction in prevalence of intestinal parasites as judged by stool examination: experimental vs control group.

C. *Process Evaluation Model for the National Nutritional Anaemia Prophylaxis Programme—A Multicentric Study*

The model to be used in this programme is shown in Fig. 3.

The sequential stages in the delivery/impact system are as follows:

i. The flow of folifer tablets from the site of manufacture to the main stocking centre; and efficiency of storage at stocking centre.

ii. The efficiency of distribution of folifer tablets by personnel of the distribution centres (SHCs) to the beneficiaries.

iii. The efficiency of receipt of inputs by the beneficiaries.

iv. The impact of inputs on the beneficiaries, i.e. pregnant women, by trimester.

The operational evaluation criteria are as follows:

i. *At site of manufacture*–Quality of tablets, whether in accordance with the prescribed specifications, and bio-availability of Fe in tablets. Suitability of packaging material and mode of transport to site of stocking.

ii. *At state stocking centre*–Supplies to be assessed for condition of supplies on receipt, storage conditions and keeping quality of tablets.

iii. *Flow of supplies to SHC*–Regularity of receipt of supplies. Adequacy of storage facilities. Mode of distribution, personnel responsible and regularity of distribution of folifer tablets. Condition of folifer tablets—both physical and chemical (Fe content and bio-availability of Fe).

iv. *Beneficiaries*–Knowledge of the programme, regularity of receipt, procedure for receipt of tablets and condition of storage at home.

The impact evaluation criteria are as follows:

i. Haemoglobin status of beneficiaries receiving folifer tablets, i.e. pregnant women, by trimester—regular versus irregular receivers.

FIGURE 3

Proposed Model for the Process Evaluation for the NNAPP Multicentric Study (ICMR)

Place of Manufacture	*At storage Centre*	*At Distribution Centre (SHC)*	*Beneficiaries (Pregnant Women)*	*Impact*
1. Quality of tablets	1. Keeping quality of tablets	1. Procedure of distribution	1. Procedure of obtaining tablets	1. Assessment of Hb status of pregnant beneficiaries by trimester
2. Packaging method	2. Condition of packing	2. Personnel for distribution	2. Condition of storage of tablets at home	
3. Transportation	3. Conditions of storage	3. Regularity of distribution	3. Regularity of receipt	
4. Bio-availability of Fe in tablets		4. Bio-availability of Fe in tablets		

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7 Indicators for Monitoring and Evaluation of Nutritional Status in the Primary and Middle School Age Group (6–15 Years)

TARA GOPALDAS AND
SHUBHADA KANANI

The school-age population forms one-fifth of the country's population. It is that segment which will form the manpower of the country a decade from now. Further, the primary life task of a schoolchild is learning. Needless to say, good health is a pre-requisite for good education. There is recent evidence to suggest that poor health and nutritional status may affect important functional areas such as work capacity and cognitive functions. Therefore, it is important to monitor and assess the nutritional and health status of this demographic group. Fortunately, this group is easily accessible for nutritional monitoring and evaluation, which is an important practical consideration to ensure a regular flow of information.

A report of the working group of the FAO[1] noted that while schoolchildren are no longer as nutritionally vulnerable as pre-schoolers, the experience of passing through the vulnerable years of early childhood leaves an imprint on the child. Thus, selected nutrition indicators measuring the nutritional status of schoolchildren can serve as proxies for development indicators for the community as a whole. In other words, the nutritional status of schoolchildren does reflect in a large measure, the nutritional status of the community to which they belong.

CRITERIA FOR SELECTING INDICATORS

i. They should be simple enough to be handled by the schoolteachers. The teachers should find them simple enough to understand and measure with reasonable accuracy.
ii. They should elicit information needed for the purposes of monitoring and evaluation, namely, 'What is the socio-economic, enrolment/attendance and overall nutritional health profile of schoolchildren

year after year, and what are the changes taking place in this respect?'

iii. There are certain types of data and statistics that can be collected and compiled by the schoolteachers and even by the older schoolchildren. These would be gross indicators such as enrolment/attendance and some selected socio-economic data. An attempt could be made to train teachers and older children in weighing and simple anthropometry and detection of gross nutritional disorders of that region. However, nutritional evaluation indicators are finer and more complex methods requiring skills of medical and nutrition personnel.

LIST OF INDICATORS FOR NUTRITIONAL MONITORING

i. *Enrolment: In terms of 'per million children' and as a percentage of eligible (6–15 years) population*

A higher percentage of eligible children enrolled in schools would mean that more and more children are accessible for nutritional health services.

ii. *Attendance as a percentage of enrolment*

A higher attendance as a percentage of enrolment would no doubt reflect high priority given by parents to education of their children; but it would also indirectly reflect the nutritional health status of the school-going children. This is so because a common reason for not attending school is illness of the student; this finding has been recently reported in a doctoral study from this department.[2]

iii. *Enrolment and attendance profile as mentioned in i and ii above for male and female children separately*

An increase in the ratio of female to male enrolment and attendance would be a positive trend not only in the matter of educational benefits to females but would also enable more female children to benefit from school health and nutritional services. Girls, especially in the pre-adolescent and adolescent age group (10–15 years), have increased needs of nutrients, especially iron. Thus, it is imperative that girls attend school right from primary (Std. I) through middle school (Std. VII) years.

iv. *Percentage of enrolled children covered by the midday meal programme*

The MDM programme in India is increasingly receiving priority in various states; it is already an important programme in Gujarat, Tamil Nadu and Karnataka. At present only about one-fifth (21 per cent) of the enrolled children are beneficiaries of this programme. An increase in number of beneficiaries would indirectly increase school attendance/enrolment and, to some extent, improve growth.

v. *Weight-for-age and height-for-age of schoolchildren*

Easy to measure, these indices, as compared to standards, give a gross picture of the nutritional plane of children. It is to be seen whether primary schoolteachers can be trained to measure and record these two simple growth indicators.

vi. *Detection of nutritional deficiencies by children*

Children themselves can be taught to detect some florid signs of nutritional deficiencies in their region. Some reports indicate that they may be better in detecting physical handicaps such as poor vision, hearing, speech etc. in their peer group than the teachers.

LIST OF INDICATORS FOR NUTRITIONAL EVALUATION

This evaluation is intended to be done by trained nutritionists on a representative school-age population at broader intervals of time, i.e. 3 to 5 years apart.

i. *Weight-for-age, height-for-age and weight-for-height*

In addition to weight- and height-for-age, weight-for-height is useful as it is age independent. This gives a more accurate picture of nutritional status as there is much variation in the heights of schoolchildren from 5 to 15 years. FAO[1] has recommended the measuring of height-for-age and weight-for-height of schoolchildren at school entry as this will give an indication of the past and current nutritional status respectively. Waterlow's classification, based on these two indices, would also give a picture of the *type* of malnutrition present, i.e. (1) stunting (chronic, long-term), (2) wasting (current, short-term), (3) stunting and wasting (both chronic and current), and (4) neither, i.e. normal.

ii. *Haemoglobin estimation*

To judge the prevalence of anaemia, haemoglobin should be estimated by the cyanmethaemoglobin method, on a stratified random subsample.

iii. *Clinical Vitamin A status*

This should be reinforced by the Rose Bengal dye test.

(a) Conjunctival lesions: xerosis and Bitot's spots.
(b) History of night blindness.
(c) Vitamin A responsive cases, i.e. those likely to respond to Vitamin A therapy. According to Sommer,[3] such cases are likely to be those with both night blindness and conjunctival lesions (xerosis and/or Bitot's spots).

At present, a history of night blindness is elicited by investigators

by interviewing the individual or, in the case of a child, the mother. This method is subject to investigator bias. The individual's responses, also, may not be reliable. Thus, there is an urgent need to develop and standardize a simple and reliable Dark-Adaptation-Test suitable for use in field conditions such as in schools or in the community. Such an attempt is being made in our department.

iv. *Dietary and nutrient intake of schoolchildren*

This information can be obtained by a simple questionnaire administered to children in which they are required only to indicate:

(a) types of foods eaten from morning to evening;
(b) quantities of the same, with the aid of standard cups of various sizes shown to them.

A detailed 24-hour-recall dietary survey in the homes of these children may not even be necessary since, in the low socio-economic group, the day-to-day menu is monotonous with little variety in the types of foods eaten.

FAO[1] has recommended that:

(a) Dietary intake information should be elicited from students in the final year of school (12–14 years) as at this age they can be expected to give reliable responses.
(b) Due to time constraints of the teacher, this information can be obtained in the form of question-and-answer sheets tick-marked by the students under the supervision of the teacher.

v. *Stool examination*

Examination of stools for the prevalence of intestinal parasites should be done on a stratified random sub-sample. Though the concentration method is more reliable, due to time-resource constraints, the simple 'saline-iodine smear' method can be carried out. This will also give a gross picture of the prevalence of intestinal parasites in schoolchildren. However, it is very difficult to obtain the necessary co-operation for this test.

The foregoing five indicators have been suggested in view of the fact that nutritional anaemia, xerophthalmia and intestinal parasites have been widely reported in the literature as being the most prevalent disorders in schoolchildren. Studies in our department have shown similar findings.

INDICATORS TO EVALUATE IMPACT OF INTERVENTIONS

In a recent longitudinal study in this department,[2] schoolchildren were treated over one school-year with iron-folate, Vitamin A and anti-parasitic drugs. The following indicators were found to be sensitive

enough to measure the impact of the intervention:

(a) Weight-for-height: Percentage of children who improved their weight-for-height and increase in percentage of children with normal weight-for-height.
(b) Haemoglobin levels by the cyanmethaemoglobin method: haemoglobin increment in experimental versus control group; percentage of responders (increase of at least 1 g/dl Hb) to the intervention.
(c) Vitamin A responsive cases: Decrease of clinical signs in experimental versus control group.

Stool examination was *not* found to be a reliable indicator to measure the impact of intervention. However, the indirect benefits of anti-parasitic drugs were evident on the above-mentioned three indicators, especially haemoglobin. We thus recommend that even where deinfestation therapy forms a part of the intervention, its effect on health may be measured through indirect indicators, e.g. increase in haemoglobin levels.

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8 Evaluation of Nutrition Education

KALYAN BAGCHI

The topic of nutrition education is highly relevant to the deliberations of a Workshop on Nutritional Monitoring and Assessment. A common indicator used for nutritional surveillance in most developing countries is the change in knowledge, attitude and practice relating to food habits with special reference to infant feeding practices in the population amongst whom nutritional intervention and programmes are in operation. Whenever a nutrition programme is under surveillance or being monitored, these inter-related indicators are commonly used since they are considered simple to obtain and interpret; which is not really the case. Nutrition education, properly conducted, can have a profound influence on these three indicators. It is but natural that evaluation of nutrition education should be regarded as an important component of a national nutrition surveillance or monitoring system. Evaluation of the impact of nutrition education, from time to time, has the potential of giving an insight into the effect of many other human development programmes in health, social welfare, education and community and rural development.

IMPORTANCE OF EDUCATION IN NUTRITION AND HEALTH PROMOTION

Nutrition and health education has been defined as educational measures for inducing desirable behavioural changes for the ultimate improvement in the nutritional and health status of individuals. This is one of the most commonly implemented measures, not only of the health sector, but of other sectors concerned with the development of human resources. Nutrition and health education has been widely used in almost all parts of the world, both in developing and in developed countries, as a measure against both malnutrition and under-nutrition. This is an activity commonly seen in many sectional programmes—health, social welfare, agricultural extension, general education, rural development—and in many other activities of related sectors. In fact, it is generally recognized that the educational process is the best means of inducing such changes in the life-style of human beings as are conducive

to their health and nutrition. Unlike the impact of other nutritional interventions like supplementary feeding, or prophylaxis with vitamin and mineral supplements, nutrition education has long-term effects.

Nutrition and health education are inseparable. Promotion of nutrition is not possible without health promotion. One cannot expect to see well-nourished children in a community where there is widespread infection and infestation as a result of poor environmental hygiene and lack of personal and food hygiene. Thus, nutrition education will not be effective if carried out in isolation since it has to take into consideration other aspects of health education with which nutrition works in a synergistic manner. For example, the conventional nutrition education for inducing better dietary practices among infants and young children will not have any impact unless and until it is linked with programmes for the control of diarrhoeal and other infectious diseases. Nutrition education activities in any developing country, without a simultaneous educational process for better personal and food hygiene and the control of diarrhoeal diseases would have no impact. Education for the promotion of immunization is indeed an indirect nutrition promoter. It has been rightly pointed out that nutrition education should be so designed as to promote desirable practices in all aspects of human life which have direct or indirect effects on nutritional status. Otherwise, nutrition education, narrowly confined to education related to food practices, will not produce the desired impact.[1,2] In India, the best example of such an approach is the Integrated Child Development Services of the Ministry of Social Welfare where nutrition education is linked with supplementary feeding, immunization, health care and formal and non-formal education. How far this integrated approach succeeds will be discussed later.

Nutrition education should form an essential component of any development programme which has as one of its objectives, improvement in the quality of life. This is not usually recognized. For example, in development programmes for women geared to increased income generation, nutrition and health education is a must, but this is rarely stated explicitly. Instances are not rare where such projects were extremely successful in significantly increasing incomes of rural women but, paradoxically, with a deterioration in the health and nutritional status of the offspring. In this context, it is heartening to note the nutritional objectives of many agricultural, rural development, community development and women development programmes.

The reasons why nutrition education has been so commonly undertaken for decades in India and other developing countries has been explained in many different forums.[3] Unfortunately, in most cases, not only in India but in most developing countries, such educational exercises have taken the form of minor routine activities with very little

concern for the methodology and the impact. In fact, there is a general feeling all over the world that the experience of nutrition education among all the nutrition intervention measures, is the most frustrating. On going through any recent review of nutrition education in the third world countries, it becomes obvious that nutrition education is undertaken with vigour, devotion and with quite considerable resources but without any thought being given to what it is actually doing to the people for whom these exercises are designed. This aspect will be discussed later during the evaluation of nutrition education.

EVALUATION OF NUTRITION EDUCATION

Nutrition education is possibly the best example of nutrition intervention which nutrition programmers all over the world tend to repeat time and again over the years without considering whether such a measure in the past did produce the desired results. Its impact in inducing the desired food practices was, and is, always taken for granted. The two other common reasons for such action on the part of nutrition programmers are operational simplicity with little cost and political or donor pressure. Nevertheless, one is amazed on the one hand at the devotion of those who do it, and the amount of resources invested in such programmes and on the other hand, at how little we know of the effects of such efforts in different parts of the world among different communities with considerably variable cultures and socio-economic planes. A glance through and review of experiences in nutrition education in any part of the world will confirm that its evaluation is a relatively uncommon event, possibly for reasons which would be discussed later.

Again, it is surprising to note that evaluation of nutrition education, though acknowledged as an important pre-requisite needing serious consideration, rarely gets adequate importance in national and international forums. I would cite only two examples of recent international meetings on nutrition education, one held in Oxford in 1980 and the other in London in 1983. It is amazing how little consideration was given by the participants of these two conferences to the specific issues of evaluation of nutrition education. This is not by accident or by chance but there are specific reasons. The only comprehensive treatment of evaluation of nutrition education, in recent years, was at a workshop conducted by Nestlé Foundation in 1980, in which evaluation of this important intervention was discussed in all its aspects.[4]

WHY IS NUTRITION EDUCATION NOT EVALUATED?

It would be interesting to consider the major causes why evaluation is not usually a component of nutrition education programmes or activities. By and large, nutrition education, as is being conducted in India

and in most developing countries, falls under two broad categories:

i. nutrition education as a relatively minor task of comprehensive health care or some social welfare system; and
ii. nutrition education as a national mass educational campaign, implemented as a vertical programme.

The major nutrition education activities being conducted in India at the moment, fall under three broad programmes.

(a) the health care system implemented by the health sector of the Central and State Governments and that implemented by non-governmental agencies;
(b) the Integrated Child Development Services implemented by the Ministry of Social Welfare of the Government of India in collaboration with the State Governments;
(c) supplementary feeding programmes implemented by the State Governments and by non-governmental agencies.

It is interesting to note that though nutrition education in all the three categories appears as an important component of the programme on paper, in actual practice it is only of secondary importance. Anyone visiting, for instance, a health centre or an anganwadi would immediately realize how insignificant are the efforts of a PHC or anganwadi worker in nutrition education. Similarly, in the supplementary feeding programmes, nutrition education forms almost a negligible part of the total process.

In recent years, it has been quite often mentioned that primary health care has great potential for delivering nutrition educational services to the people who need them most through peripheral workers who are expected to know the community much better than 'imported' health workers. In fact, community health workers and peripheral workers of various categories from other sectors are being trained to conduct realistic nutrition education using appropriate messages and methodologies. A distinct change can be observed in the training guidelines and manuals in this respect in recent years.[5,6] However, on-the-spot situation analysis in various countries in different parts of the world has revealed that nutrition education continues to be a routine exercise of very little importance to the supervisors and of no interest to the workers. The multipurpose worker, too busy with his or her curative and preventive work, has no time or patience to conduct effectively such educational exercises in a manner which would have an impact on the behaviour of the audience. Similarly, a major portion of the time of the anganwadi worker is spent on managing supplementary feeding which is the most expensive and visible part of the ICDS programme at the anganwadi level. She has not the time or the energy nor, possibly, the required skill, to conduct realistic nutrition education

Thus, evaluation of nutrition education, a minor component of

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these massive national programmes, has never been taken seriously for obvious reasons. For instance, when the primary health care system is evaluated, there are other indicators which are used for evaluation which are not necessarily related to the evaluation of the impact of nutrition education. Similarly, in the evaluation of ICDS, improvement in the knowledge, behaviour and practice of the mothers is of very little concern to the evaluator. So also, in the evaluation of the supplementary feeding programme, the impact of major programmes becomes a matter of great urgency. It is a matter of gratification that the National Institute of Public Cooperation and Child Development and the Ministry of Social Welfare of the Government of India are in the process of developing a monitoring system for the nutrition education component of the ICDS programme. It should, however, be noted that implementing a monitoring system for a national programme of the magnitude of the ICDS is not a simple task. The success of a monitoring or evaluation system depends on the reliability of the data from the periphery—and this is where most monitoring or evaluation falters.

Nutrition education, as a major vertical programme, has been in operation in a number of countries, in several forms, e.g. as a mass campaign through films, through video network, through television, through newspaper insertions and by other means. These are specially mounted vertical programmes, most commonly sponsored by some external donor agencies interested in some aspects of the programme, and conducted in a manner which in most cases is not replicable in the national context. However, such programmes have definitely an important evaluation component which is time-consuming, needing highly specialized technical skill and staff, and financial resources. I do not think that this type of evaluation is of much relevance to most developing countries. These are only useful academic exercises and give feedback for others.

WHAT CONSTITUTES EVALUATION?

There are different and conflicting views as to what constitutes evaluation of nutrition education. Some of the questions posed are as follows:

(a) Is it the evaluation of the process?
(b) Is it the evaluation of the outcome?
(c) If it is the evaluation of the outcome, is it the knowledge, attitude or practice of the beneficiaries that is to be evaluated?
(d) Are the nutritional anthropometric indicators the last word in assessing outcome?
(e) Should one be satisfied if the evaluation considers whether the messages

are realistic and based on the cultural and behavioural patterns of the beneficiaries?

(f) Should an evaluation also consider the cost, the cost-effectiveness and the cost-benefits of a nutrition education exercise?

These are some of the questions which are being asked again and again in various national and international forums with no conclusive decision. By and large, nutrition education evaluation, like nutrition education itself, is in a fluid state. It should be realized that those in charge of administering peripheral workers who actually conduct nutrition education, prefer process evaluation as a continuous process at the grassroots level, whereas the governments or the donors or sponsors tend to prefer impact evaluation at long intervals or at the end of the programme by external evaluators. Evaluation of nutrition education, as is commonly practised in most developing countries, becomes a difficult process since what is done is based on a combination of nutritional, humanitarian and political justifications.

POSSIBLE INDICATORS FOR THE EVALUATION OF NUTRITION EDUCATION

The question which has been bothering all those involved in nutrition education programmes is how to measure their effects. What are the parameters which can be used for monitoring a nutrition education programme or for measuring its outcome?

Obviously, the answer, on the basis of the definition of nutrition education, is an improvement in the nutritional status of those to whom the education is being imparted. It is, therefore, argued that nutritional anthropometry should be used as an indicator for assessing the impact of nutrition education. If nutrition messages have been successfully conveyed to the people, the improved dietary practices adopted by them must be revealed by nutritional anthropometry.

On the other hand, it is argued that the improvement of nutritional status in terms of nutritional anthropometry is influenced by a host of factors of which improvement of behavioural practices related to feeding is only one. For example, a nutrition education programme might have made the people aware of the importance of sound feeding practices, especially for their children. But the availability of food in the area might be severely deficient during certain seasons, or the purchasing power of the beneficiaries may be so limited that they cannot make the best use of their increased awareness for the improvement of their dietary habits. On the other hand, even with a poor educational exercise, the presence of a development programme in the area might provide better health care services, better immunization coverage, safe water supply and improved purchasing power, leading to an improvement of health

and nutritional status. It is quite difficult to pinpoint the causes of improvement or deterioration of nutritional status of the community since this is the outcome of interaction among a large number of variables. Thus, anthropometric or clinical data cannot be regarded as indicators of the impact of nutrition education in a normal situation.

Outcome evaluation is usually measured in terms of knowledge, attitude and practice. Changes in these may be the outcome of nutrition education and their measurement is important. The assessment of nutritional concepts and knowledge within the community is of the greatest use in the early phases of a programme, but a plateau is usually rapidly reached. Therefore, the measurements become of little use as the mothers learn what is expected of them. It must be mentioned in this connection that assessment of knowledge can lead to dangerous interpretations. For instance, imparting regular 'lectures' to a group of mothers might lead to increase in their 'knowledge' in such a way that when they are assessed, they are able to repeat answers almost accurately. Later investigations may reveal that this increased knowledge has not motivated them or changed their attitudes, and their practices might remain as they were before.

Attitude assessment requires rather more sophisticated approaches for which routine workers like the primary health care workers and the anganwadi worker have neither the time nor the skill. Very often the results of such sophisticated evaluation done by outside skilled evaluators are already known to the peripheral workers who work with the community. But they usually refrain from revealing their own assessment. Practices are probably the most valuable measurements and the most easily made if they are distinguishable by 'markers' characteristic of the teaching programme. They can best be observed and best recorded during home visits made unexpectedly by a health worker who is known to the community. Diet and food preparation practices for infant and child feeding can best be observed by random visits at different times of the day. Similarly, breast-feeding can be monitored and encouraged during home visits. In assessing such food practices during the evaluation, there is no place for dietary recall or weighed dietary intakes, an important point which should be borne in mind. Quite often, during evaluation the investigators would ask the mother about the infant and child feeding practices by recalling what she had done during the last 48 hours. Such type of recall recording can only be done by well trained and skilled evaluators and observers. The most authentic type of outcome evaluation is the nutritional status of the beneficiaries. However, it must be mentioned that the relationship of such changes in nutritional status to the educational input in the nutrition education programme is very difficult to establish. Nutrition education is only one input into programmes which may include

supplementary feeding, improved hygiene, water supply and knowledge of diarrhoeal and other infectious diseases, all of which influence the measurement of growth and nutritional status. However, as the ultimate outcome, it is still important to know whether they are changing for the better.

There is quite a lot of controversy as to what type of measurements will have to be included in the evaluation process and can also be used as indicators for the nutrition surveillance system. Birth weight, body weight, body length, mid-upper-arm-circumference, head and chest circumference and their ratios, height at school entry, maternal height, and clinical signs of malnutrition are some indicators which are commonly used for assessing.

It is becoming increasingly clear that behavioural practices related to infant and child feeding and child rearing are strongly determined by a number of factors. The dietary and rearing habits of mothers in any given culture are dependent on factors which determine their behavioural practices. The reason why a mother feeds her infant in a particular way or adopts some child-rearing practices is dependent not so much on the availability of food or her knowledge or awareness about the importance of food and nutrition but on many other extraneous factors linked to her day-to-day life and the cultural and social practices imposed on her. The trend now is to find out why a mother in a particular culture feeds her infant in a particular way. Similarly, when she rears a child in a particular way, there are strong reasons behind it. Unless and until these factors influencing behavioural practices in the mothers are understood and messages given accordingly, no amount of nutrition or health education on conventional patterns would be of any benefit. Nutrition and health education will only be effective when the messages are directed towards these behavioural determinants to produce desirable changes. It is not always necessary to change the behavioural factors if these have a solid, scientific foundation. For doing this, measures which are outside the health and social welfare sectors will have to be undertaken. For instance, a common nutrition education message used in most developing countries is to give a young child small, frequent feeds. Anyone aware of the life-style of a rural woman will understand that this is an almost impossible message to be followed by the mother unless and until there is someone at home who can undertake this responsibility. Usually, there is none on whom she can depend. The responsibilities of feeding the child are entrusted to an older sibling or other elderly relatives, with undesirable effects. Even if such a mother receives nutrition education, this might lead to an increase in knowledge and even a change in her attitude, but probably not in her practice of child-feeding since this may be beyond her capability. It is thus becoming more important to assess the practices in the

evaluation of nutrition education. Proper recording of practices by observation can be a reliable parameter for evaluation.

Process evaluation is more feasible than the impact or outcome evaluation in most situations. If process evaluation is properly organized, it can definitely throw up quite a lot of information from which indirect conclusions could be drawn regarding its outcome. Process evaluation will have to include:

(a) evaluation of the appropriateness of the messages, of the teaching methods and the use of teaching aids; and
(b) methods of recording, e.g. the use of the growth chart, which, when properly recorded, is an excellent process for imparting education. Similarly, recorded growth charts can give an indication of the outcome of educational efforts.

Some other items of a routine nature in process evaluation deal with frequency of session, infrastructures, profile of indicators and other issues related to administrative arrangements.

In conclusion, it must again be emphasized that there is no set model or method for evaluating nutrition education. However, the programmers must decide what indicators are to be used for evaluation according to the existing situation and other development inputs among the beneficiaries. Evaluation of the programmes based on increase of awareness and knowledge, a method very commonly used, is inappropriate. A judicious combination of process indicators and an assessment of the change in practice can in most cases give excellent and reliable results for the evaluation of nutrition education.

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9 The Grey Area of Monitoring and Evaluation of Nutrition Health Education Programmes

SUBADRA SESHADRI

Although nutrition and health education has always been a part of nutrition programmes, albeit indirectly (some teaching-learning taking place in a programme), the need for specifically designed nutrition education programmes has received an impetus only since the sixties when nutrition education was given the same priority as that of other programme/project activities. Education in nutrition has been considered a necessary part of practical programmes to improve human nutrition, the recommended channels for imparting it being schools, MCH programmes and community development programmes.

Most types of nutrition interventions such as feeding programmes, immunization or growth surveillance, require an educational component to teach the beneficiaries how to effectively use the services of the programme. Nutrition health education in nutrition programmes and the programmes themselves play a mutually reinforcing role, the latter acting as major channels for transmitting nutrition messages.

The nutrition education component, like a feeding programme or other nutrition programmes, needs to be observed systematically for a realistic assessment of how the services are delivered and utilized. The continuous observation and collection of data at the field level on how the programme is delivered and utilized may be defined as monitoring. It is an in-built mechanism to steer the programme towards achieving the expected outcome.

MONITORING

In the initial stages of the programme, monitoring indicators need to take cognizance of the following:

(a) Adequacy of personnel available and in position to impart nutrition health education.
(b) Adequacy of training received by the personnel.
(c) Efficiency of the delivery pattern as the programme gets going, i.e.

number of sessions actually delivered vs the targeted number of sessions.

(d) Exposure rate, i.e. the number actually attending vs the targeted attendance.

Most of the nutrition education programmes in the past were based on the so-called 'KABNS' model (Knowledge, Attitude, Behaviour and Nutritional Status). The model itself is based on the idea that nutrition-related problems are mainly due to a lack of relevant knowledge and skills and if we transmit this knowledge (nutrition messages) successfully, it will lead to behavioural changes which culminate in improved nutritional status. However, it is becoming increasingly clear that gain in knowledge may not necessarily lead to change in practice. Therefore, an alternate model, the behaviourist model is being developed. Whatever the model, in transmitting messages successfully, both message content and communicability of message are important considerations. Communicability is defined by Webster's New World Dictionary as the quality of being communicable. Communicable is defined as something that can be communicated or transmitted. To communicate is to make known information, messages etc. The definition of communicability being what it is, parameters to monitor it are very limited. The objectivity of these is not easy to establish. Some of the parameters that have been used to judge communicability of a message are:

(a) Do the audience show sustained interest in what is being communicated while the message or information is actually being delivered (by group observation)?

(b) After the message has been delivered, do the audience indicate that they were interested in it (by questioning the audience in groups or by asking them to respond to a rating scale)?

(c) Are the audience able to recall the gist of the message (by administering an interview schedule)?

(d) What communication channels are being used for the transmission of the message?

Methods or procedures for collecting these data have varied from observations and group discussions with the participants to attempts at greater standardization, such as the use of rating scales.

i. Group observation includes marking the attention span of the audience, interest as shown by audience participation, and the activities that are indicative of restlessness, boredom, lack of interest etc. When this method is used, it is obvious that the investigators cannot be observers. Independent observers must be posted; they must remain unobtrusive and must carry out their observations without making it obvious to the audience. More than one observer is necessary, preferably three or four, depending on the size of the group. Observers must independently tabulate their responses before compiling them. This raises

the question of manpower and cost for monitoring communicability.

ii. Group discussions with the participants have also been used effectively by some investigators. However, there is the danger that the more vocal among the group may dominate the discussion and the views of the silent majority may not be reflected during the discussions. Attempts will have to be made to draw as many out as possible. Data may also be collected from a group by asking them to respond to rating scales in writing, which is time-saving. However, with illiterate participants or semi-literate participants, this method does not work. The alternative is oral assessment, which may again be done in groups or by interviewing individuals. The latter is time-consuming but will provide worthwhile information. To improve objectivity, the rating scales should be preferably subjected to some preliminary measures to test validity and reliability. Validity, specificity and sensitivity of the measures for monitoring communicability are difficult to establish by any objective methods.

iii. Ability to recall the message may be ensured by interviewing the participants either individually or in a group. There is greater scope for standardization of the instruments for knowledge gains, which is perhaps one of the reasons that it has been the most extensively used measure both for monitoring and for impact evaluation of nutrition education programmes. Procedures are available for validation of the instrument such as face validity, criterion validity etc. Procedures are also available for establishing reliability such as the split-half method or test-retest method.

iv. It is now reasonably well established that transmission of messages must be backed by the use of appropriate media for better communicability. It is necessary to monitor the communication channels, so that the best combination may be selected.

EVALUATION

When one is satisfied that messages have been successfully transmitted, one must look for behaviour changes. The parameters to be used for behaviour changes elude standardization. Methods for collecting the data are no less demanding.

Behaviour change is defined as an individual changing from what are considered to be undesirable practices, from the point of view of being conducive to good nutritional status or good health, to desirable practices. The most reliable way of collecting this information is perhaps by the method of participant observation and by living with the community. However, this is not practicable for investigators who undertake a one-time project or programme and who have other institutional responsibilities. At the field worker's level this is practicable, although intensive training would be needed. A pre- and post-assessment of the expected

behaviours should be carried out to know the impact of the programme. A control group, not exposed to the programme and comparable in other respects, is essential for interpretation.

As part of impact parameters, attitudinal changes are included. However, in view of the difficulties in measuring attitudes and in view of the fact that the ultimate goal of nutrition health education is to bring about a change in nutrition and health practices or behaviour, attitudinal measures as evaluative or monitoring parameters are not discussed here.

If the messages transmitted have resulted in a shift in the nutrition and health practices in the desirable direction, then the effect of this should be reflected in improved nutritional status. As previous speakers have already mentioned the various parameters for assessment of nutritional status, their specificity and sensitivity, they are not covered here.

INTERPRETATION AND GENERALIZATIONS

Most nutrition education programmes form part of a larger feeding programme, or of integrated programmes comprising several inputs. The problem with such programmes is that a favourable impact obtained is not necessarily due to any one component. The difficulty in ascribing the effects to a nutrition education component is even more difficult as tangible benefits due to an educational programme on nutritional status may only be seen after a time interval needed for changes to occur and take root. On the other hand, gain in knowledge and change in practice are more clear indicators of the impact of the programme in the short run.

A CASE STUDY

The department had recently undertaken a project sponsored by the World Health Organization (WHO) to prepare and introduce a relevant nutrition health education kit for the field functionaries of the ICDS. As a preliminary step, a socio-economic and nutritional and health status survey was carried out on the target group beneficiaries. The level of nutrition-health knowledge and current practices of the mothers were also assessed. A similar survey of knowledge was carried out on the anganwadi workers. Using the survey findings a Nutrition Health Education (NHE) kit has been developed and tested. This is being used by the functionaries to educate the mothers. Process information such as the number of mothers attending the sessions, number of units delivered, exposure rate etc. will be collected for evaluation. Knowledge gains and practice changes at the end of the project will be

used in conjunction with process evaluation for a full evaluation of the project. Additionally, participant evaluation will also be used to assess the programme in meeting the need, namely, providing a simple and relevant NHE kit to the field functionaries of the ICDS, which they can comprehend easily and use in their daily contact with mothers.

10 Role and Development of National Nutrition Monitoring Bureau (the Apex Nutrition Monitoring Body)

N. PRAHALAD RAO &
J. GOWRINATH SHASTRY

One of the essential pre-requisites of programme planning and management, be it in the field of agriculture or economics or health including nutrition, or any aspect of human activity, is a sound information system capable of providing reliable data which are relevant to the activity and have a representative character. In the context of nutrition, information on food production, demography, food consumption pattern, health and nutritional status of the population constitutes the most relevant data base.

In India, a number of agencies have been collecting the above-mentioned information from the beginning of the century. But it is only since the fifties that a more systematic approach is being attempted in its collection and compilation. With an increasing emphasis on planned development through five-year plans, a number of organizations and departments geared their activities to generating facts and figures to meet the stringent needs of the planning process at national and regional levels. The major agencies and the type of information they are collecting for the use of various departments are shown in Table 1. The National Nutrition Monitoring Bureau, which was established in 1972 by the Indian Council of Medical Research (ICMR), forms one of the important sources of information on diet and nutritional status in the country. In this paper the genesis, role and development of the bureau and its scope as a central agency for nutrition-related information is briefly discussed.

GENESIS

The assessment of nutritional status of different segments of the population, particularly in relation to dietary intakes, has been one of the

TABLE 1

Major Agencies and Type of Information Collected

	Agency	*Type of information*
1	NNMB	Diet and nutrition surveys Evaluation of ongoing nutrition programmes
2.	NSSO	Consumer expenditure surveys Socio-economic survey Employment position
3.	DES	Food production, distribution, procurement and storage Consumer price index Food availability
4.	FNB	Diet and nutrition surveys
5.	CBHT	Vital statistics Public health and medical statistics Community health surveys
6.	REGISTAR GENERAL OF INDIA	Census reports Population statistics and trends

important activities of nutrition research in India for more than six decades. These have been mostly isolated studies, either of specific groups or in specific regions of the country and they rarely assumed an all-India character. Such surveys have been carried out by different agencies. The most notable among them are:

(a) National Institute of Nutrition, Indian Council of Medical Research
(b) Department of Food, Food and Nutrition Board, Ministry of Food and Civil Supplies
(c) Nutrition division of state directorates of health services
(d) Educational institutions such as colleges of home science, medicine, agriculture etc.

The results of these surveys conducted during 1918-1955 did help to identify the major nutritional problems and their extent in the community. Data on these surveys upto 1955 have been compiled by the ICMR[1,2] Since these surveys had limited goals to meet the immediate need of the particular agency involved in assessment, the results often differed in their emphasis and objective. These surveys invariably suffered from certain limitations, e.g.

i. the area surveyed was not always representative;
ii. uniform or standard procedures had not been followed;
iii. the content of the surveys often varied widely;
iv. there has been little or no follow-up action.

Under the auspices of the ICMR and NIN, during the sixties extensive nutrition surveys and carefully planned consumption studies of specific groups like pre-school children were carried out, and specific problems like PEM, Vitamin A deficiency and anaemia were studied. The results of these surveys[3,4] did identify energy rather than protein as the major limiting factor in the diets of urban and rural pre-school children. This observation was contrary to the earlier belief held by nutritionists. Confirmation of these findings was made by undertaking supplementation studies[5] in communities and observing growth performance of children.

It may be mentioned that current national nutrition programmes like the control of PEM through SNP, Vitamin A deficiency through a massive dose of Vitamin A[6] and anaemia among vulnerable segments through folifer distribution[7] have a scientific basis in such studies. These studies were highly specific, goal-oriented and essentially one-time studies, and did not provide for a continuous flow of data capable of use for nutrition monitoring and surveillance.

To overcome the above-mentioned limitations of the earlier surveys/studies, in 1972 the ICMR set up the National Nutrition Monitoring Bureau (NNMB), with a Central Reference Laboratory (CRL) at the NIN, Hyderabad and 10 peripheral units, one each in the states of Andhra Pradesh, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Tamil Nadu, Uttar Pradesh and West Bengal.

The main objectives of the NNMB are twofold:

i. To continuously collect and process information on nutritional status and dietary intakes of representative segments of population in the country, making use of standardized procedures and techniques.
ii. To periodically undertake the impact evaluation of ongoing nutrition programmes.

ORGANIZATION

The CRL functions as a nodal point of the bureau and provides technical direction, supervision and coordination in respect of the activities of the various state units. Its main responsibilities include development of survey protocols, imparting training to the field personnel (e.g. medical officers, nutritionists), sample selection, supply of equipment, provision of technical guidance to all the state units and, more importantly, compilation and analysis of data and reporting of the results for use by different agencies. Another important activity of the CRL is to plan and conduct evaluation of national nutrition programmes.

STATE UNIT

The unit in the state is under the administrative control of the State Nutrition Officer or an officer of the State Health Directorate. He/she

ensures cooperation from local governments at all levels for undertaking surveys. The staff, in each unit, consists of a medical officer, one nutritionist, an auxiliary nurse midwife and one attendant. Each unit is provided with a vehicle and driver.

The entire operational cost of the bureau is borne by the ICMR. The state governments provide physical facilities like office space, secretarial assistance etc. The State Nutrition Officer acts as a liaison between the NIN (ICMR) and the state government and 'uses his good office' for facilitating the survey.

SURVEY CONTENT AND METHODOLOGY

Each unit plans to cover in one calendar year a total sample of 500 households in rural areas and 250 households in urban areas. Every year, in each state, the rural sample is spread over four districts selected on the basis of developmental stage. The urban sample includes white collar workers of low, middle and high income groups, industrial labourers and slum dwellers.

The subjects surveyed include infants, pre-school children, school-children, adolescents and adults, pregnant and lactating women. The following investigations are carried out on all the selected households:

(1) Clinical assessment and anthropometry on all the available subjects.
(2) Diet surveys through weighment of raw food (for estimating consumption at household level) and 24-hour recall method or oral questionnaire, wherein the intake of cooked food by each individual within the household is assessed (the latter method of diet survey was undertaken in 20 per cent of the households covered under diet surveys).
(3) Demographic and socio-economic particulars.

DATA ANALYSIS AND REPORTING

The data collected by each state unit is analysed separately and reported every year. Since its inception in 1972 upto 1982, the bureau has covered 39,129 households under diet surveys and 2,43,536 subjects for nutritional status. The reports, which are brought out annually, include information on the following aspects of diet and nutritional status of population classified (wherever possible) according to broad socio-economic and physical age-sex groups:

i. Average food and nutrient consumption at household and individual level.
ii. Based on intake levels, classification of households as well as individuals according to protein and calorie adequacy with computation of their relative position.
iii. Average anthropometric measurements for age (body weight, height, mid-upper-arm-circumference and fat fold at triceps).

iv. Growth status of pre-school children in terms of weight-for-age deficit (Gomez classification).
v. Prevalence figures of various nutritional deficiency signs.

Although a considerable amount of data is gathered under the NNMB it is felt that it has not been fully utilized for predicting nutritional situation and planning appropriate strategies. There is an urgent need for establishing a data management system for better and fuller utilization of NNMB data and also for modelling of the data towards planning and formultation of practical strategies. Efforts are being made currently to set up such a system at the NIN to handle NNMB data and other field and experimental data generated by the Institute. A proposal to acquire a 32-bit computer system along with the appropriate software capabilities for efficient handling of data in a comprehensive manner is under study by the ICMR.

EVALUATION OF ONGOING NUTRITION PROGRAMMES

Evaluation of ongoing nutrition programmes is the other important activity of the NNMB. Based on information about the nutritional and dietary status of the population, Vitamin A deficiency, anaemia and PEM have been identified as major nutrition problems in India. To combat these problems, the National Institute of Nutrition, as part of its research programmes, evolved a number of action programmes which are effective as well as feasible under controlled field conditions. Some of these programmes are as follows:

(a) Calorie supplementation to prevent PEM among pre-school children
(b) Programme of massive dose of Vitamin A to combat nutritional blindness among pre-school children
(c) Anaemia prophylaxis programme for pregnant women and children with folifer tablets
(d) Salt fortification programme to prevent iron deficiency in the population.

All these programmes except salt fortification (which has been initiated recently) have been implemented by all the state governments as public health nutrition programmes involving large financial outlays.

One of the functions of the NNMB, particularly the CRL, has been to evaluate these ongoing nutrition programmes and to make recommendations to the governments for modification and improvement, if necessary. These evaluations cover the following programmes:

i. Vitamin A prophylaxis programme
ii. Special nutrition programme
iii. World Food Programme–assisted supplementary feeding programme
iv. India Population Project

v. Applied Nutrition Programme

As a result of these evaluations, a number of shortcomings mainly in the implementation of these programmes have been identified. Many of the programmes were found not to have had their expected impact for the following reasons:

(a) Poor implementation of the programme;
(b) Irregular supply of inputs;
(c) Lack of awareness and motivation on the part of the functionaries as well as the beneficiaries.

In the case of the supplementary feeding programme, the problem of the supplement acting as a substitute and of being shared by other members of the family has been seen as a factor diluting the desired effects. These findings have led to mid-course corrections in the implementation of the programme.

SPECIAL STUDIES

The bureau, in addition to the routine reporting of the data, has undertaken/undertakes research exercises seeking answers to certain specific questions of practical relevance. The results of such past exercises are briefly summarized here.

1. *Quality of diets*

   The quality of the diets as judged by protein-calories (percentage of calories derived from protein) has been found to be satisfactory irrespective of the levels of dietary consumption. In other words, the quantity of food consumed showed considerable variation but its protein content remained relatively uniform.[8]

2. *Intra-family distribution of food*

   (a) The age-old belief that the adult male member of the family consumes the lion's share of the food and the women tend to suffer was not fully supported. The analysis of the data showed that the distribution of men and women in the adequate/inadequate categories was the same in 75 per cent of the families. In the majority of the rest it was found that the consumption status of women was adequate, while that of the male member was inadequate (18.5 per cent). In the remaining 6.5 per cent of the households the men consumed adequate amounts of calories while the women consumed inadequate amounts of calories.[9]

   (b) The intra-family distribution of food was studied with a view to finding differences in the relative position of the pre-school children in a nuclear and a joint family with respect to the calorie consumption. The analysis revealed that the position of the pre-

school child was worse in a nuclear family as compared to joint families. Also the chances of a pre-school child receiving adequate calories decreased with increase in the size of the family.[10]

3. *Food cost*

Based on the cost of various foodstuffs at the retail level, the cost of the diet as consumed at the survey time was evaluated and subsequently the cost of the same diet which would provide 2,400 calories was calculated. This exercise revealed that the cost of this diet was found to vary within the range of Rs 1.71 in West Bengal to Rs 1.19 in Gujarat. The remaining states fell within this range. From this, it is evident that the regional variations in calorie intake of the rural population are not due to any marked differences in the cost of the foodstuffs.[11]

4. *Clinical nutrition status vs growth status in children*

The association of clinical nutritional status with that of growth status (weight-for-age as assessed by Gomez grades) was studied in pre-schoolers. 15.6 per cent of the children without nutritional deficiency signs were found to have 'normal' body weight status, while only 7.4 per cent of children with signs of nutritional deficiency were found to fall under this category. While 3 per cent of those without nutritional deficiency signs were suffering from severe growth retardation, 12 per cent of the children exhibiting signs of nutritional deficiency fell under this category.[12]

5. *Use of mid-upper-arm-circumference in the assessment of PEM*

The efficacy of measuring mid-upper-arm-circumference in identifying children suffering from different degrees of under-nutrition was studied. The results indicated the existence of 57 per cent and 73 per cent agreement in the assessment using mid-upper-arm-circumference on the one hand, and weight-for-age and weight-for-height respectively on the other. Some children, who were severely undernourished on the basis of weight-for-age, weight-for-height and muscle circumference, were classified as normal based on mid-upper-arm-circumference.[13]

6. *Variation in estimates of under-nutrition using heights and weights*

The results showed that the degree of malnutrition varied from 76–97 per cent depending upon the criteria used.[14]

COMMENTS

Since its inception in 1972 the NNMB has been functioning as a single national agency collecting data on food consumption, anthropometry and clinical status in terms of nutritional deficiencies from representative

segments of the population. The data are unique in the sense that they have been collected uniformly with due regard for sampling and standardized survey techniques by centrally trained personnel. Since the data were collected on a continuous basis, it was thought that they would lend themselves to 'measurement' of changes in dietary and nutritional status of people over time; and these changes, when interpreted in conjunction with ongoing intervention programmes, might reflect the efficacy or otherwise of the intervention programmes, thus serving the purpose of 'monitoring' as well as of 'evaluation'.

However, the experience suggested that the data, though found useful in identification of the nutritionally vulnerable segments of people and their socio-economic characteristics, and in helping to understand time trends in food consumption pattern and nutritional status in a general way, were found wanting in delineating the impact of specific intervention programmes. This was mainly due to the fact that most of the intervention programmes were area-based and more often population-specific. Hence, they tended to be 'patchy' in distribution. However, the data base generated by the NNMB was meant to reflect the situation of the state as a whole. As such, the sample sizes covered in each state did not allow disaggregation to smaller levels of districts and blocks—the levels at which most of the programmes were implemented. Thus the monitoring bureau data could not be effectively made use of either for programme monitoring or impact evaluation of nutrition programmes.

A closer look at the objectives and design of the survey suggests that prediction of impending food and nutrition crises was never considered as an objective of the bureau. Also the 'monitoring' and 'evaluation' functions which were expected of the bureau were not a part of the explicitly stated objectives. They were there by implication rather than by design. Nevertheless, the bureau did generate extensive data on diet and nutritional status of the population, which are reliable and useful for the following:

i. Studying time trends at state level:
ii. Identifying nutritionally vulnerable segments of population; and
iii. Indicating changes, if any, in consumption patterns and nutritional status at state level.

In the context of nutritional surveillance, the role of predictive indicators is well recognized. Considering the type of information collected by the bureau and the sampling design adopted, it will not be possible to use the present system of nutritional surveillance to provide a timely warning of impending food crises. However, the NNMB could be suitably modified so as to serve the purpose of surveillance of nutritional status at the state level. This could be accomplished with additional inputs of data on rainfall, food production, marketing, employment and price

structure which are known to provide predictive indicators.

Realizing these limitations, the Expert Group of the Council on NNMB recently recommended that the bureau should endeavour to link its operations with the NSSO and other relevant departments such as Agriculture, Meteorology, Civil Supplies, Commerce etc. In this context, it is pertinent to mention here that during 1983–84 the bureau had established links with the NSSO to enhance the value of data bases collected by these two national agencies.

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11 The Unexplored Realms of Social Monitoring/Evaluation and Social Accountability of Nutrition Programmes

A. K. IYENGAR &
K. G. KRISHNAMURTHY

Nutrition programmes at the national level have been mainly supplementary feeding programmes for the vulnerable groups, introduced in the plans to bridge the calorie gap and to combat the problem of malnutrition. Various programmes are currently in operation but the major ones include the Special Nutrition Programme for pre-school children and the Midday Meal Programme for schoolchildren. Supplementary nutrition is also provided in integrated programmes like the ICDS and other projects. In the integrated nutrition programmes attention has been focused on the provision of health services, immunization, potable water, hygiene and sanitation measures.

The nutritional status of the population cannot be attributed to the effect of a particular intervention such as health or nutrition or an economic factor, and would depend on a combination of both social and economic development. This is evident from Table 1, which compares the situation in the States of Kerala and Punjab. Kerala has a higher degree of social development in terms of literacy, birth rate and IMR, but poor economic development as 46 per cent of its population are below the poverty line and 75 per cent of the households experience calorie inadequacy. Punjab, on the other hand, has better economic development but poor social development despite a per capita investment twice that of Kerala for health and social services. States like Bihar, Madhya Pradesh and Uttar Pradesh have both poor economic and social development despite a per capita investment almost equal to the national average. The table also reveals that there is no relationship between the degree of investment and the achievement of targets especially pertaining to health and nutritional standards. It is, therefore, clear that financial and physical monitoring of progress in health

TABLE 1

Comparative Social and Economic Development in a few States

State	*Percentage of households with calorie inadequacy**	*Rural IMR (1980)†*	*Rural birth rate (1980)†*	*Percentage literacy‡*		*Percentage below poverty line (Rural) §*	*Per capita outlay for Sixth Plan (Rs)*	
				Total	*Female*		*Health*	*Social Services*
Kerala	75.0	41	26.2	69.2	64.5	46.0	14.4	120:5
Punjab	—	96	29.8	40.7	34.1	11.9	29.9	222.4
Uttar Pradesh	67.3	167	40.9	27.4	14.4	58.9	12.2	76.9
Madhya Pradesh	52.8	152	38.5	27.8	15.5	59.8	18.0	95.9
Bihar	—	—	36.5	26.0	13.6	58.9	11.8	63.2
Rajasthan	—	115	37.5	24.0	11.3	33.8	11.9	112.4
All India	44.2	124	34.8	36.2	24.9	50.8	17.8	149.5

* NNMB Annual Report 1980
† Registrar General of India, Vital Statistics Division
‡ Educational statistics 1980–81, Ministry of Education, New Delhi
§ Sixth Plan 1980–85, Planning Commission, New Delhi
— Figures not available

or nutrition programmes does not reflect the true achievement.

Assessments of nutrition programmes have been based mainly on observations on the improvement of health and nutritional status of the beneficiaries and the effectiveness of the delivery of services. Monitoring of nutrition programmes at the national level too has relied on financial and physical targets and achievements.

Relatively less importance has been paid to social factors such as education, determinants of food choices and eating habits, socio-economic influences, knowledge, attitudes and practices, and communication methods which are known to influence the nutritional standards.

Nutrition is thus seen mainly as a scientific discipline although the solution to many of the nutritional problems lies in an understanding of social, psychological and economic factors.

Social aspects of nutrition programmes such as education, particularly health and nutrition education, knowledge, attitudes and practices among beneficiaries, and communication methods which do influence nutritional and health standards, call for a higher priority if their impact is to be currently assessed.

Inadequacies in this area include the following:

(a) Failure by the implementing agencies to give sufficient priority to preventive nutrition.
(b) Failure to apply basic communication and educational principles to health and nutrition education.
(c) Failure to take account of the needs, desires and lifestyles of the individuals.
(d) Failure to provide suitable and requisite material for guidance and use by the personnel of the implementing agencies.
(e) Failure to coordinate activities in various sectors.

Some of the important social aspects bearing on monitoring and evaluation of the nutrition programmes are nutrition and health education, cognitive development among children, food choice and eating habits, awareness about health and nutrition, communication methods, cleanliness and hygiene among beneficiaries and community participation.

This paper presents some of these factors that were evaluated in the ICDS programme. The programme, which is currently in operation in about 1000 blocks in the country, envisages delivery of the following services in an integrated and coordinated manner:

(1) Supplementary nutrition
(2) Health check-up
(3) Immunization
(4) Non-formal education
(5) Referral services
(6) Health and nutrition education

For the present study a total of 124 villages were surveyed. The anganwadi worker was interviewed through a detailed questionnaire for perception and delivery of services. At least five family members and either the village panchayat or president were interviewed for knowledge, attitudes and practices, perception of the programme components and its effects, and community contribution. In all, there were 744 respondents of whom 620 were beneficiary family members and 124 panchayat members.

RESULTS

Cleanliness and personal hygiene

Of the 124 anganwadi centres surveyed, 80 centres (65 per cent) had clean surroundings and only 19 centres (15 per cent) had toilet facilities (Table 2) leaving considerable scope for improvement of environmental hygiene. The personal hygiene of children (hair, nails and dress) was also poor (Table 3).

TABLE 2

Cleanliness and Sanitation at the Anganwadis

Type of Anganwadi	*Surroundings*		*Toilet facility*	
	Clean	*Not clean*	*Present*	*Absent*
Rural	33	20	1	52
Tribal	29	16	2	43
Urban	18	8	16	10
Total	80	44	19	105

Nutrition and health education

This was conspicuously absent in all the centres surveyed. The personnel responsible for implementing this component were not aware of the significance of this component nor were they in a position to deliver the services efficiently.

Comprehension and cognitive development among pre-school children

The overall response to cognition and comprehension among pre-school children was quite satisfactory. They were able to identify fruits, vegetables, animals and birds, numbers and letters (Table 4).

Community participation

Details of community participation are presented in Table 5. On an

TABLE 3

Observations on the Personal Hygiene of Children

Type of Anganwadi	*Personal Hygiene*															
	Nails cut				*Dress*				*Cleanliness of dress*				*Combing of hair*			
	For all	*For most*	*For some*	*For few*	*All fully clad*	*Most fully clad*	*Some fully clad*	*Few fully clad*	*All were clean*	*Most were clean*	*Some were clean*	*Few were clean*	*All well combed*	*Most well combed*	*Some well combed*	*Few well combed*
	10	*7–9*	*4–6*	*1–3*	*10*	*7–9*	*4–6*	*1–3*	*10*	*7–9*	*4–6*	*1–3*	*10*	*7–9*	*4–6*	*1–3*
Rural	0	19	20	14	10	20	17	6	4	9	16	24	3	16	18	16
Tribal	5	13	16	11	2	19	12	12	1	11	16	17	0	11	21	13
Urban	4	15	5	2	4	14	7	1	2	12	11	1	6	12	8	0
Total	9	47	41	27	16	53	36	19	7	32	43	42	9	39	47	29
Percentage of total	7	38	33	22	13	43	29	15	6	25	35	34	7	31	39	23

(Figures represent the number of anganwadis)

TABLE 4

Comprehension and Cognitive Development among Children

Type of Anganwadi	*Identification of pictures, fruits, vegetables etc.*					*Story telling, recitation etc.*				
	All of them could identify 10	*Most of them could identify 7–9*	*Some of them could identify 4–6*	*Few of them could identify 1–3*	*None of them could identify 0*	*All of them could do so 10*	*Most of them could do so 7–9*	*Some of them could do so 4–6*	*Few of them could do so 1–3*	*None of them could do so 0*
Rural	4	24	9	14	2	6	22	6	10	9
Tribal	1	25	8	7	4	1	23	14	7	0
Urban	0	14	8	4	0	4	11	9	2	0
Total	5	63	25	25	6	11	56	29	19	9
Percentage of total	4	51	20	20	5	9	45	23	15	8

TABLE 5

Community Participation

Group	*Would like to contribute to the programme*			*Nature of Contribution*							
	Yes	*No*	*Not aware*	*Financial*	*Land*	*Building*	*Equip-ment*	*Grains*	*Firewood*	*Vegetables*	*Labour*
Beneficiary families	338 (54)	268 (43)	14 (3)	7 (2)	0 (0)	4 (1)	4 (2)	86 (88)	190 (58)	42 (12)	244 (72)
Panchayat members	53 (43)	71 (57)	0 (0)	1 (2)	30 (57)	39 (74)	3 (6)	2 (4)	17 (32)	0 (0)	0 (0)
Total	391 (52)	339 (46)	14 (2)	8 (2)	30 (8)	43 (11)	7 (2)	88 (22)	213 (54)	42 (11)	244 (62)

(Figures in brackets are percentages of the total)

average 52 per cent of the respondents were in favour of contributing to the programme while 46 per cent were not in favour and 2 per cent were unaware of any contributions to be made. The nature of contribution included financial aid, land, building, equipment, grains, firewood, vegetables and labour and ranged from 2 per cent to 62 per cent among those who were in favour of contributing to the programme.

Family planning (Table 6)

About 61 per cent of the respondents were in favour of family planning while 24 per cent of them were not in favour and 15 per cent were not aware of practices related to the small family norm. Among those who were in favour, 14 per cent preferred the upper limit of four or more children.

TABLE 6

Opinion of Respondents on Family Planning

Group	*Family Planning*			*Opinion on the Size of the Family*			
	In favour	*Not in favour*	*Not aware*	*1 child*	*2 children*	*3 children*	*4 or more children*
Beneficiary families	410	165	45	5	104	240	61
Panchayat Members	42	14	68	0	14	25	3
Total	452 (61)	179 (24)	113 (15)	5 (1)	118 (26)	265 (59)	64 (14)

(Figures in brackets are percentages of the total).

Supplementary nutrition (Table 7)

About 10 per cent of the respondents were not aware of the inclusion of this component in the programme although three respondents mentioned that supplementary feeding was not in operation. Of those who mentioned that feeding did take place at the centres, 67 per cent opined that it helped growth among children, 13 per cent suggested that it prevented diseases, and the remainder gave reasons irrelevant to the context of the programme.

Vitamin A and iron distribution (Table 8)

Of the 744 respondents, 381 (51 per cent) mentioned that the programme included vitamin A and iron distribution, while 217 (29 per cent) and 146 (21 per cent) respondents respectively stated that the component

TABLE 7

Awareness of Respondents about Supplementary Nutrition

Group	*Programme includes supplementary nutrition*			*If yes, programme*		
	Yes	*No*	*Not aware*	*Helps growth*	*Prevents diseases*	*Others*
Beneficiary families	605	2	13	404	79	113
Panchayat members	66	1	57	43	6	17
Total	671	3	70	447	85	130
	(90)	(0.4)	(9.6)	(67)	(13)	(20)

(Figures in brackets are percentages of the total)

TABLE 8

Awareness of Respondents towards Prophylaxis Programmes

Group	*Programme includes vitamin and iron distribution*			*If yes, programme*			
	Yes	*No*	*Not aware*	*Helps prevent blindness*	*Prevents diseases*	*Helps growth*	*Others*
Beneficiary families	345	194	81	131	98	91	23
Panchayat members	36	23	65	11	11	11	3
Total	381	217	146	142	109	102	26
	(51)	(29)	(20)	37	29	28	7

(Figures in brackets are percentages of the total)

was lacking or were unaware of such a service in the programme. Of those who were aware of the provision of Vitamin A and iron prophylaxis measures, around 50 per cent suggested that these prevented blindness; another 20 per cent opined that they either prevented diseases or helped growth, while 7 per cent gave answers of no relevance to the programme.

COMMENTS BY THE AUTHORS

Cleanliness and personal hygiene

As mentioned earlier, although 65 per cent of the centres had clean surroundings, only 15 per cent had toilet facilities. Open-air easing by children cuts at the root of sanitation and deters the achievement of better health standards. Of the total 744 respondents, 310 mentioned that their children had attacks of diarrhoea during the last one year and in the majority of cases more than once. Personal hygiene among children again left much to be desired. This reflects either the inability of the anganwadi worker to attend fully to the personal hygiene of the children, or the existence of a communication gap between the worker and the mothers of the children in motivating them to practise cleanliness.

Nutrition and health education

There was a conspicuous gap in the awareness and delivery of nutrition and health education. This was because the content imparted to trainers and supervisory field personnel, who delivered the services, was vague and unclear. The educational material and equipment were generally unavailable in the regional languages and the programmes also lacked visual demonstrations. Proper schemes utilizing the various mass media techniques backed up by suitable audio-visual demonstrations were lacking. The scheme of integrated education in nutrition, health, hygiene and sanitation formulated by the Union Department of Food, which is likely to commence in the Seventh Plan, envisages the use of the existing infrastructure and the media for delivery of services. However, it would be really important to coordinate its implementation at various levels if the desired result is to be achieved.

Community participation

The success of a welfare programme depends upon the extent to which the community contributes towards it. Most welfare programmes have little impact if they are viewed by people as charity or doles from the government. Although awareness towards participation existed among 98 per cent of the respondents, 46 per cent of them considered the programme as a dole. Lack of proper motivation by the implementing agencies to stimulate community participation at various levels has been the major drawback. This would have to be given serious thought in view of the resource constraints and growing inflationary trends.

Family Planning

The concept of family planning, adoption of the small family norm, adequate spacing and its implications for maternal and child mortality

and health status have yet to make a dent on the surveyed population. This is evident from the fact that some of those who were in favour of family planning preferred to have four or more children. In the surveyed areas it was also observed that there was reluctance to discuss family limitation concepts in mixed company or in public.

Nutrition intervention and prophylaxis components

The existence of a significant proportion who said they were unaware of the components of the prophylaxis programme, reflects the lacunae in dissemination of specific and relevant information on the programme, or the extent of illiteracy among the respondents. Those who were aware of the services but attributed the effects to irrelevant causes reflect the ineffective communication of messages.

This study reveals that there is a need for monitoring social aspects in nutrition programmes. These could be in terms of health and nutrition education, attitudes and awareness, community participation etc., or any service relevant to the programme. But what is more important is that the services pertaining to social aspects must be delivered effectively and in coordination with other intervention services. It would be necessary to impart training on the various social aspects using simple audio-visual demonstrations, and in different regional languages so that the same could be communicated effectively. Also steps would have to be taken by the field-level functionaries to motivate community participation if the impact of the nutrition programme is to be felt. The study also revealed that the field functionaries require knowledge about simple and relevant nutrition and health education. They would then have to decide how best the minimum and relevant matter can be communicated to the beneficiaries.

12 The Grey Area of Cost-Effectiveness and Cost-Benefit Analysis of Nutrition Programmes

MARY ANN ANDERSON

Let me begin by saying that I am a nutritionist, not an economist and therefore would like to make a disclaimer about my expertise on the assigned topic. However, I do feel comfortable sharing with you some examples of how I and other project planners and evaluators have worked with economists to adapt and apply the tools of cost-benefit and cost-effectiveness analyses to nutrition planning. In this paper I will briefly discuss some useful definitions of cost-effectiveness and cost-benefit analyses and methodologies for carrying them out. Finally, I will present some examples of how cost-effectiveness and cost-benefit analyses have been applied in project planning and evaluation, which should illustrate some of the key concepts.

The essential purpose of analysing cost-effectiveness and cost-benefit of nutrition programmes is to *measure the efficiency* of these programmes. While knowledge of the implementation and outcome of programmes is highly useful, in many cases it is crucial to be informed about how programme costs compare with their outcomes. The developing field of cost-benefit analysis provides a frame of reference for relating costs to benefits in either monetary terms or in terms of units of impact or outcome. While nutrition programmes may be more difficult to assess in cost-benefit terms than engineering and technical interventions, it is possible to undertake a cost-benefit analysis. Such analysis can be useful in determining the allocation of resources for intervention efforts and for influencing policy and planning groups and political constituencies who determine the fate of social intervention efforts.

Cost-benefit and cost-effectiveness studies can be undertaken during the programme planning phase. Such efforts have great utility, although the necessary empirical and experienced information needed to undertake them appropriately may not be available. But while the conduct of these ex-ante analyses is limited by practical considerations,

it is usually feasible to undertake either cost-benefit or cost-effectiveness analysis as part of the assessment of project outcome. These ex-post analyses are important potential inputs for the subsequent planning and decision-making processes.

I have listed the key concepts in this field to standardize our definitions and understanding of terms. For now, let us focus on two essential definitions: (1) Cost-benefit analysis and, (2) Cost-effectiveness analysis.

KEY CONCEPTS[1]

Accounting Perspectives: The various perspectives which underlie decisions in which categories of goods and services are included as costs or benefits in an analysis.

Benefits: Project net outcomes, usually translated into monetary terms. Benefits may include both direct and indirect effects.

Benefit-to-Cost Ratio: The total discounted benefits divided by the total discounted costs.

Costs: Inputs, both direct and indirect, required to produce an intervention.

Cost-Benefit Analysis: The economic efficiency of a programme expressed as the relationship between costs and outcomes, usually measured in monetary terms.

Cost-Effectiveness: The efficacy of a programme in achieving given goals measured substantively in relation to the programme costs, usually expressed as cost per unit of outcome achieved.

Discounting: The treatment of time in valuing costs and benefits, or the adjustment of costs and benefits to their present values, requiring a choice of discount rate and time-frame.

Ex-Ante Analysis: Analysis undertaken prior to programme implementation to estimate net outcome in relation to costs. Ex-ante analyses are usually undertaken as a part of programme planning.

Ex Post Analysis: Analysis undertaken after net outcome effects are known.

Internal Rate of Return: The calculated value for the discounted rate necessary for total discounted programme benefits to equal total discounted programme costs.

Net Benefits: The total discounted benefits minus the total discounted costs. (Also called Net Return).

Opportunity Costs: The value of opportunities foregone because of an intervention project.

Shadow Prices: Adjustment of actual prices for goods and services to take into account market price distortions.

Cost-effectiveness and cost-benefit analyses can help decision makers to choose the most economical and effective intervention for achieving a particular goal. Such information would make it possible to compare, for example, the merits of various nutrition programme approaches to achieve a particular goal, such as nutrition education, vitamin and mineral fortification, supplementary feeding, home gardens, distribution of vitamins and mineral supplements etc. Which one to fund on a large scale needs to be decided primarily in terms of the relation between cost and outcome. The objective is to put limited resources to optimal use. While other factors including political considerations come into play, the preferred alternative usually is one which produces the most impact on the most targets for the same expenditure. This simple principle is the basic idea behind cost-benefit and cost-effectiveness analyses techniques that provide systematic approaches to resource allocation. The application of cost-benefit and cost-effectiveness analyses to resource allocation decisions for social programmes is still a new field. Their wider application is still limited by unsolved problems of measurement and conceptualization, requirements of extensive data, and the diffuseness of the actual resource allocation processes in social programmes. Whether or not a programme can be implemented and whether or not, if implemented, it has an effect, are always problematic issues. The application of cost-benefit and cost-effectiveness analyses to completed programmes without having obtained the data for impact assessments is not justified.

THE CONCEPT OF COST-BENEFIT AND COST-EFFECTIVENESS

A comprehensive *cost-benefit analysis* requires estimates of the benefits of a programme, both tangible and intangible, and the costs of undertaking the programme, both direct and indirect. Once specified, the benefits and costs are then translated into a common measure, usually (not necessarily) a monetary unit. The benefits and costs can then be compared, generally by computing either a benefit-to-cost ratio (benefits divided by costs), the net benefits (benefits minus costs), or some other value (internal rate of return) for summarizing the results of the analysis.

Cost-benefit analysis requires the adoption of a certain economic perspective and, in addition, certain assumptions must be made in order to translate programme inputs and outputs into monetary figures. There is disagreement as to which specific procedures to utilize. Moreover, the assumptions made in developing definitions and measures of costs and benefits influence strongly the resulting conclusions. All the data required for cost-benefit calculations are seldom available.

Cost-benefit analysis is especially appropriate to technical and

industrial projects where it is reasonable to place a monetary value on benefits as well as costs. Some examples might include engineering projects designed to reduce the costs of electricity to consumers, to increase the ease of transportation with new roads, or irrigation projects to increase crop yields. A monetary estimation of benefits, however, is not possible in many social programmes where setting a monetary value on benefits may be virtually impossible, or where, in the best of circumstances, only a portion of the known programme outputs may be reasonably valued. The issues are complex when attempting to monetize the benefits of nutrition and health interventions, since ultimately one has to place a value on human life in order to fully monetize programme benefits.

For these reasons, *cost-effectiveness analysis* rather than cost-benefit analysis is often seen as the more appropriate technique for resource allocation considerations in respect of social intervention. Cost-effectiveness requires quantifying programme costs and benefits, but the benefits do not have to be monetized, only the costs. For example, a nutrition rehabilitation centre could have cost-effectiveness findings expressed as follows: At a total annual cost of Rs 40,000/- a typical centre reduced the prevalence of moderate and severe malnutrition in the village served by 33 per cent. For cost-effectiveness analysis, then, the outputs or benefits are expressed in terms of the actual substantive outcomes rather than in monetary values. That is, the efficacy of a programme in attaining given goals is assessed in relation to the monetary value of the resources or costs put into the programme. For example, alternative nutrition interventions may be analysed by measuring their respective impact on nutrition status expressed in protein-energy malnutrition (PEM) prevalence rates, then relating them to programme costs.

A cost-effectiveness analysis allows comparison and ranking of choices among potential programmes according to the magnitude of their effects relative to their costs. Put differently, the comparison is stated in terms of units of effectiveness for achieving particular outcomes. Most cost-effectiveness analyses of programmes can be considered an extension of impact evaluation, not a substitution for such evaluation. They provide a refined way of reporting and communicating impact results to policy and decision makers.

COST-BENEFIT ANALYSIS

In the simplest terms, efficiency of interventions means that the benefits derived from a project must be greater than its costs. What is required, then, is the calculation of programme benefits and costs. Benefits are the net outcomes derived from a programme, both tangible

and intangible; for example, the benefits of a nutrition project may include the reduction of malnutrition, illness or mortality and increased economic productivity. It is important to consider a number of factors in determining whether to undertake a cost-benefit analysis. In some evaluation contexts, the technique is feasible, useful and a logical component of a comprehensive evaluation, while in other contexts its application may rest on dubious assumptions and be of limited utility. Optimal requisites for an ex-post cost-benefit analysis of a nutrition programme are as follows:

(1) The programme has independent or separable funding.
(2) The programme is beyond the development stage and there is certainty that the net effects are significant.
(3) Programme impact and magnitude of impact are known or can be validly estimated.
(4) Benefits can be reduced to monetary terms.
(5) Alternative programmes are under consideration.

Cost-benefit analysis facilitates the comparison of the economic efficiency of programme alternatives, even when the interventions are not aimed at common goals. However, after some initial attempts to use cost-benefit analysis in the social fields in the early 1970s, evaluators have become uneasy about comparing directly cost-benefit calculations for say nutrition, family planning, health, housing or educational projects. It is simply not possible to obtain agreement, for example, on how to place a monetary value on a life prevented by a fertility control project, or the value of a life saved by a nutrition or health campaign, and then compare the results.

The problems of measuring all the benefits, including indirect and external benefits, of intervention projects and expressing those social benefits in monetary terms are often so great that a complete cost-benefit evaluation may not be possible. However, cost-effectiveness analysis may be a much more feasible and realistic approach in evaluating economic issues.

Cost-effectiveness analysis does not require that benefits and costs be reduced to a common denominator. Instead, the effectiveness of a programme in reaching given goals is related to the monetary value of the resources going into the programme. In cost-effectiveness analyses, programmes with similar objectives are evaluated and the costs of alternative programmes for achieving the same goals can be compared. For example, various programmes aimed at lowering the infant mortality rate can be compared.

Cost-effectiveness facilitates the comparisons and rank-ordering of programmes in terms of their costs for reaching given goals, or the various inputs required for different degrees of goal achievement. But since the benefits are not converted to the same common denominator, one

can neither ascertain the worth or merit of any single given project, nor assess which of two or more projects in different areas produces better returns. One can only compare the relative efficiency, in respect to each other, of programmes with the same or similar goals, where efficiency is a function of minimal costs.

SOME PRACTICAL GUIDELINES FOR ASSESSING COSTS

In this section, some practical guidelines for determining what to include as costs of a programme are set forth. These suggestions should be used with caution, however, because they represent an attempt to simplify what can become extremely complicated if sophisticated accounting and economic methods are used. Thus, recognizing the shortcomings, they should be taken as a starting point toward simplification. Finally, what costs to include and how to value them depend on the accounting perspectives used and obviously on the type of programme being assessed. I will use supplementary nutrition programmes as my example here since this is the nutrition intervention with which I am most familiar. This is also the largest nutrition programme in India in terms of resources invested.

Programme costs are *all* the resources (i.e. goods and services) that go into the project. The first step is to examine the programme description to construct an exhaustive list of all the 'ingredients' that constitute the programme. The major categories usually are: personnel, training, transport facilities, food commodities, materials and equipment. A close scrutiny of programme budgets, accounts and other records yield some of these. Finally, all other costs should be found and specified. All of these should be valued first at the costs actually paid by the project; details of these costs are needed for formal accounting records. To underline the importance of including the cost of all programme inputs, attention may be drawn to several reports published recently on the Integrated Child Development Services Scheme (ICDS) which mention the cost of the programme but include neither the cost of training the workers, nor the cost of the food commodities used in supplementary nutrition. Our analyses have found that food inputs alone represent more than half the total cost of the ICDS.

However, the accounting costs are not necessarily equal to the real costs of the programme for purposes of evaluation. The real costs to society include not merely the expenses, but a variety of hidden or social costs, for example, the costs of goods or services donated to the programme. In the case of donated goods, the calculation is relatively straightforward, but the value of labour or a participant's contributed time is more complex. If the time could have been utilized in other work, e.g. in harvesting crops, that value should be considered as a

programme cost, although it will vary with the season and with the person participating or contributing the labour to the programme. However, it should also be mentioned that the inclusion of such costs represents a theoretical ideal that is seldom achieved in practice.

The same may be said of 'shadow prices', sometimes calculated to determine the real value to society of resources employed. For instance, wages paid may be greater than the opportunity cost of labour when unemployment is high. In such cases, the shadow wage rate may be less than the market price paid. Similarly, imported inputs that require foreign exchange may have to be shadow priced because of the difference between real and nominal exchange rates.

Finally, the costs of resources shared by more than one programme need to be kept in mind. A health clinic or a school may be used as a food distribution site; personnel handling food distribution may also provide other services. The costs of such shared resources must be allocated correctly, e.g. on the basis of time spent or space used—or the programme cost evaluation will be misleading. However, the principle of marginality may be applied when appropriate, i.e. a cost need not be attributed to the programme if it would have been incurred in another programme in any case.

Accounting and costing systems for feeding programmes must not be overly elaborate. They require relatively simple operations with few inputs and repetitive functions. A qualified accountant can help set up and service the necessary ledgers, and ordinary clerical personnel can maintain the records. The social costing necessitates keeping separate records for non-purchased items and applying shadow prices (if they exist) when evaluating the project. Guidance on these procedures can be obtained from economists.

Reporting costs for evaluation is the final important procedural issue. Costs have no meaning when reported by themselves; they must be related to something. For example, comparisons of actual with budget expenditures are useful for control purposes. For evaluation purposes, costs need to be related to programme performance. Frequently, nutrition project costs are presented as the cost per recipient. This can cloak the fact that some of the recipients are not malnourished. If the programme aims at alleviating malnutrition and giving priority to currently malnourished children, then the relevant figure is the cost per target-group member reached. The difference between the cost per recipent and cost per target-group member represents economic leakage due to coverage of non-target recipients. If feeding programmes fail to have nutritional status admission criteria or are not operating in areas of high malnutrition prevalence, then the excess coverage can be significant. Non-target group leakage can also occur in take-home programmes because the food is shared by other family members, and

studies have found that mothers feed the target-group children only about one-half of the ration, while the rest is given to other children. Sharing is clearly a significant economic leakage.

However, even calculating the cost per target-group recipient fails to relate costs to nutritional impact completely. Here is where we come back to the need for cost-benefit or cost-effectiveness analyses. Supplementary feeding is intended to decrease nutrient deficits. Thus, one should attempt to calculate the cost of closing or reducing the nutrient gap. The cost of the nutrients consumed from the ration by the target child is not sufficient because substitution is likely to occur. The supplementary ration will displace a portion of the food previously consumed so that the net dietary gain will be the ration minus the decrease in the ordinary diet. In other words, cost would be related to the net diet gain (post-supplement nutrient intake minus pre-supplement nutrient intake), which allows for the quantity of nutrients lost through substitution. Leakages attributed to such causes amounted to 53 per cent as revealed by a study of the Special Nutrition Programme (SNP) in Tamil Nadu.

Reducing the nutrient intake gap still does not provide a clear proof of nutritional status improvement. Consequently, costs should also be related to actual changes in nutritional status as reflected by anthropometric measures.

RULE OF THUMB FOR CALCULATING COSTS

A rule of thumb for calculating programme costs suggested by Levin[2] and Rossi *et al.* is summarized briefly here. The estimation of costs for all programme inputs listed should be undertaken with an effort proportionate to the budget component that each of the categories represents. For example, if 75 per cent of a programme budget is allocated for personnel costs, the cost-benefit analyst should spend about three-fourths of his or her time determining personnel costs. If transportation costs amount to only 1 per cent of the total budget, only a short time corresponding to 1 per cent needs to be spent itemizing them. In short, large budget items require more care and small categories call for proportionately smaller amounts of attention.

The suggestion is based on the logic that in estimating large categories, even small errors will cumulate and end up as large measurement errors. But large errors in calculating small categories, on the other hand, will produce smaller measurement errors. For example, consider a programme that costs a total of $1 million, in which personnel costs are 75 per cent or $750,000 and transportation costs 1 per cent or $10,000. A 10 per cent error in calculating personnel costs amounts to $75,000, whereas a 50 per cent error in transportation costs involves

only $5,000. Hence large categories deserve proportionately more attention. The same rule also applies to the calculation of benefits.

EXAMPLES OF COST-EFFECTIVENESS AND COST-BENEFIT ANALYSES

Tables 1 and 2 show examples of ways in which costs of supplementary nutrition programmes in various countries have been presented. It is readily apparent that food comprises the major share of the cost of such programmes. Tables 3 and 4 show the first steps toward relating supplementary nutrition programme costs to efficiency of services delivered, e.g. cost per calories delivered, cost per child with calorie or anthropometric deficiency and cost per net increase in calories consumed. The wide variation in costs between countries in Table 4 reflects differences in ration size and quality, nutritional status of recipients and leakages. The increasingly high costs as one reads from left to right across the chart reinforce the economic importance of targeting interventions precisely and designing programmes to minimize leakages.

Cost-effectiveness evaluations of nutrition rehabilitation centres (NRC) have been attempted as shown in Table 5. Beaudry-Darisme

TABLE 1

Cost per Child per Year of CARE Pre-School Feeding Programmes in Five Countries–in US $ (1976)

Country	*Total cost per child per year*	*Food*	*Distribution*	*Adminis-tration*	*Local operating expenses*
Colombia					
Take-home	24.75	13.41	2.01	4.56	4.77
Costa Rica					
On-site	94.54	70.58	0.00	2.46	21.50
Dominican Republic					
Dry, Take-home	13.55	10.34	0.72	1.42	1.07
Wet, Take-home	15.24	10.34	0.72	1.46	2.72
India (Tamil Nadu)					
On-site	14.46	10.69	0.21	0.69	2.87
Take-home	14.38	13.30	0.21	0.68	0.19
Pakistan					
Take-home	23.51	16.64	0.54	5.50	0.83

SOURCE: Anderson *et al.*, 1981[3]

TABLE 2

Project Poshak Annual Cost Per Child–Extensive Phase (1973)

	US $	*% of Total*
Food–ICSM	11.61	76.1
Transportation: port to feeding centre	.69	4.5
Storage & transport equipment costs	.32	2.1
Nutrition education materials	.75	2.1
Other materials	.63	4.1
Personnel	1.25	8.2
Total	15.25	99.9

SOURCE: Adapted from Gopaldas *et al.*, 1975[4]

TABLE 3

Cost per kilogram and Nutrient of Food Delivered in CARE Pre-School Feeding Programmes in Five Countries—in US $

Country	*Cost per kilogram of food delivered*	*Cost per 100 calories delivered*	*Cost per 100 grams protein delivered*
Colombia			
Take-home	0.825	0.022	0.037
Cost Rica*			
On-site	0.985	0.045	0.109
Dominican Republic			
Take-home			
Wet daily	0.470	0.012	0.023
Dry monthly	0.418	0.011	0.021
India (Tamil Nadu)*			
On-site	0.463	0.015	0.031
Pakistan			
Take-home	1.224	0.022	0.084

SOURCE: Anderson *et al.*, 1981[3]

*Costs in the Costa Rican and Indian on-site feeding programmes have been adjusted because food is served only six days a week (288 days per year), whereas in the other programmes food is provided daily for take-home consumption.

and Latham[5] tried to relate costs to changes in nutritional status. The changes attributable to the NRC were measured by comparing the treated with a non-treated group. The cost per child showing positive weight-for-age gain was $103 whereas the cost increased nearly fivefold to $605 when only the children who improved more than the

control group were considered. This analysis reveals how the cost-effectiveness ratio can worsen as more stringent nutritional improvement criteria are applied.

TABLE 4

Annual Feeding Programme Costs in Four Countries (in US $)

	Annual cost per child	*Per child with calorie deficit*	*Per child with anthropometric deficiency(a)*	*Per 300 calories net daily diet gain(b)*
Colombia				
Take-home	24.75	29.11	260.53	89.79
Dominican Republic				
Dry, Take-home	13.55	14.89	66.10	240.90
Wet, Take-home	15.24	16.75	74.34	94.17
Pakistan				
Take-home	23.51	28.67	45.39	298.94
Costa Rica				
On-site	94.54	112.21	290.00	98.55

SOURCE: Anderson *et al.*, 1981[3]

(a) i.e, costs divided by number of children who were below normal compared to standard growth indicators

(b) i.e costs divided by number of children who after supplementation actually increased their calorie intake by at least 300 calories

TABLE 5

NRC Cost-Effectiveness Measures

Nutritional improvement criteria	*Cost per child (US $)*	
	Haiti	*Guatemala*
Receive services	72	214
Show positive weight-for-age change	103	301
Show weight-for-age change 'greater' than control	605	2672
Decrease 3rd degree PCM 'greater' than control	3627	5344

SOURCE: Adapted from Beaudry-Darisme and Latham, 1973[5]

TABLE 6

Lesotho Cost Effectiveness

Data Category	*Urban Clinics*				*Lowland Clinics*					*Mountain Clinics*				
	Queen Elizabeth Maseru	*Tayete Yaneng*	*Leribe*	*Total Clinics*	*Tsakholo*	*St. Paul Butha Butha*	*Molokas*	*St. Paul Peka**	*Total Clinics*	*Quin-thing*	*St. James Mokhotlong*	*St. James Mon-tsonyene-yene*	*Total Clinics*	*Total Lesotho Sample All Clinics*
Synectics Sample size	94	191	176	461	185	135	119	—	439	163	154	195	512	1412
UCLA Sample size	—	—	—	283	—	—	—	—	902	—	—	—	508	1693
UCLA % Malnourished	—	—	—	17.3	—	—	—	—	19.5	—	—	—	29.6	22.2
Non-clinic UCLA % Malnourished	—	—	—	22.3	—	—	—	—	24.6	—	—	—	36.6	27.8
Synectics % Malnourished	10.7	11.0	9.1	10.2	17.3	17.0	15.2	—	16.6	14.7	26.6	27.2	22.8	16.5
% Improvement in nutritional status	11.6	11.3	13.2	12.1	7.3	7.6	9.4	—	8.0	21.9	10.0	9.4	13.8	11.3
% of cases of malnutrition averted	—	—	—	54.3	—	—	—	—	32.5	—	—	—	36.6	41.1
No. of Clinic attenders (recip)	704	2704	805	—	1711	2761	706	—	—	2914	1421	628	—	1595
No. of Cases of malnutrition averted (range)	82–85	306–327	97–106	—	125–137	210–221	56–66	—	—	318–390	142–190	59–84	—	166
$ Cost/case of malnutrition averted (range)	51–53	303–324	316–345	—	321–351	591–622	442–520	—	—	128–209	264–354	477–680	—	325
$ Cost/case of malnutrition averted. Without supplementary foods (range)	51–53	20–22	32–35	—	43–47	17–19	42–50	—	—	15–30	22–29	57–81	—	28

SOURCE: Austin et al., 1981[6]

*Not included due to unreliable synectics data.

Table 6 presents results of a cost-effectiveness analysis of an integrated programme offering selective health services, supplementary feeding, and family planning in Lesotho.[6] Taking the number of regular clinic attenders and the difference between the percentage that would have been malnourished under baseline conditions and the percentage of malnourished clinic attenders, it was possible to calculate the number of cases of malnutrition that had been averted. It was estimated that there was an average of 166 fewer cases of malnutrition per centre because of the integrated pre-school intervention. The next step in the analysis was to calculate the cost of each case of malnutrition averted. This was done by dividing the total costs per centre by the number of cases of malnutrition averted in that centre. The mean cost per case of malnutrition averted was $325 for all clinics including supplementary feeding. The non-food costs per malnutrition case averted were only $28. All regions covered by these clinics showed a 32 per cent reduction in the number of malnourished children.

Table 7 illustrates the application of cost-effectiveness analysis to deciding which services in a primary health programme will be most cost-effective for reducing infant and young child mortality. Based on

TABLE 7

Estimated Annual Costs of Different Systems of Health Intervention

Interventions	*Per capita cost ($)*	*Cost per infant and/or child death averted* ($)*
Basic primary health care†		
Range	0.40–7.50	144–20,000 (I)
Median	2.00	700
Mosquito control for Malaria	2.00	600 (I)
Onchocerciasis control programme	0.90	Few infant and child deaths
Mollusc control for Schistosomiasis	3.70	Few infant and child deaths
Community water supplies and sanitation	30–54	3600–4300 (IC)
Narangwal nutrition supplementation	1.75	213 (I) 3000 (C)
Selective primary health care‡	0.25	200–250 (IC)

SOURCE: Walsh and Warren, 1979[7]

* 'I' denotes infant and 'C' child

† Delivered by village health workers

‡ In this case, delivered by mobile units

their analyses, Walsh and Warren[7] have recommended a selective approach to primary health care which would include those interventions which are cheapest per infant or child death averted. They recommend that the principal recipients of care should be children up to three years old and women in the childbearing years. The care provided should include measles and diphtheria-pertussis-tetanus (DPT) vaccination for children over six months old, tetanus toxoid to all women of childbearing age, encouragement of long-term breast-feeding, provision of chloroquine tablets for episodes of fever in children under three years old in areas where malaria is prevalent and, finally, oral rehydration packets and instruction. They predict that if even 50 per cent of the children and their mothers and 50 per cent of the pregnant women in a community were contacted, deaths from measles would be expected to decrease by at least 50 per cent, deaths from whooping cough by 30 per cent, from neonatal tetanus by 45 per cent, from diarrhoea by 25 to 30 per cent and from malaria by 25 per cent.

Table 8 illustrates a cost-benefit study for a family planning programme.

Tables 9–13 and Figure 1 are taken from an economic analysis done by Makinen[9] as part of the design stage of the USAID assisted ICDS project. This project expects to significantly reduce the incidence of malnutrition and infant and young child mortality. The project goals are that the prevalence of severe malnutrition in children under three years of age will be reduced by one half and moderate and severe malnutrition together reduced by 35 per cent within four years of programme operation in any given site. The infant mortality rate is expected to decline by 25 per cent and the mortality rate in the 13–36 months age group by 33 per cent in communities within six years after an anganwadi is established. For a typical block of 100,000 population the number of severely malnourished children should fall from 8,400 to 5,530. (Severe malnutrition has been defined as 60 per cent of standard weight-for-age and moderate malnutrition as 60–70 per cent of standard weight-for-age, using Harvard standards). It was projected that 20 per cent of the children 0–3 years would be severely malnourished and 28 per cent moderately malnourished in the AID assisted area.

The risk of mortality for the severely malnourished child has been shown to be 12 times the normal, while it is 3 times the normal for the moderately malnourished child.[10] By reducing the incidence of malnutrition and supplementing those who are malnourished, the current young-child (1–4 years) mortality rate of about 30 should be reduced to below 20. The efforts made toward raising birth weights, assuring safe aseptic deliveries, promoting oral rehydration, providing immunization and improving breast milk and weaning food adequacy are expected to reduce the infant mortality rate from 136 to 102 in ICDS areas. Table 9 and Figure 1 show the expected results on malnutrition and mortality

after four years of ICDS operation in a typical block. It is expected that 266 infant and child deaths will be averted annually in each block.

An attempt was made to quantify certain economic benefits of the ICDS as a result of preventing malnutrition and averting deaths in childhood, namely the future productivity benefit, the advanced earnings benefit, and the food savings benefit. Not enough information is currently available to quantify the economic benefits of increased acceptance of family planning, resource savings on health care, mothers' time and strength savings and health benefits to the community at large. It should be stressed that to all the economic benefits calculated, the pure utility gains of young-child deaths averted and illnesses and malnutrition prevented must be added. Table 10 shows the annual costs (including staff, equipment, supplies and training) and expected results of implementing the project in an average AID assisted rural block of 147,000 population. Note that the numbers of malnutrition cases averted and deaths averted reach their maximum beginning in 1988 after the block will have been operational for four years.

The cost per malnutrition case averted (Table 11) is high in the early years of the project, then declines to a low of $188 after four years of

TABLE 8

The Costs and Benefits of a Family Planning Programme—Benefit/Cost Ratios and Net Return Summaries

A cost-benefit analysis of the family planning programme in the United Arab Republic estimated the benefits and costs of a prevented birth as follows:

Benefits

(a) The main effect–the consumption expenditures that would have been required for an averted birth and which are now available to the population;
(b) The wage productivity effect–the increase in output resulting from better nutrition of smaller sized families; and
(c) The increase in total public savings resulting from the diversion of resources that would have been required to educate the averted birth.

Costs

(a) The magnitude of the loss of output resulting from a smaller labour force as the result of the delayed effects of lower fertility; and
(b) The costs of averting a birth through the provision of family planning services.

The final summary table is given below.

TABLE 8 (*contd.*)

Summary of Various Effects

	(Egyptian pounds per prevented birth)	
	10% discount rate	*10% discount rate*
Benefits		
1. Consumption	222, 351	109, 206
2. Wage productivity effect	16, 21	9, 14
3. Public savings effect	37	24
4. Total	275, 409	142, 244
Costs		
5. Productivity	79, 91	24, 31
6. Family Planning Services	4, 20	
7. Total	83, 111	28, 51
8. Difference between benefits and costs (Row 4 minus Row 7)	164, 326	91, 216
9. Benefit-cost ratios (Row 4/Row 7)	2.5, 4.9	2.8, 8.7

SOURCE: Zaidan, 1971[8] and Rossi *et al*, 1979[1]

When two figures appear in a column, they reflect alternative assumptions made in the calculations.

TABLE 9

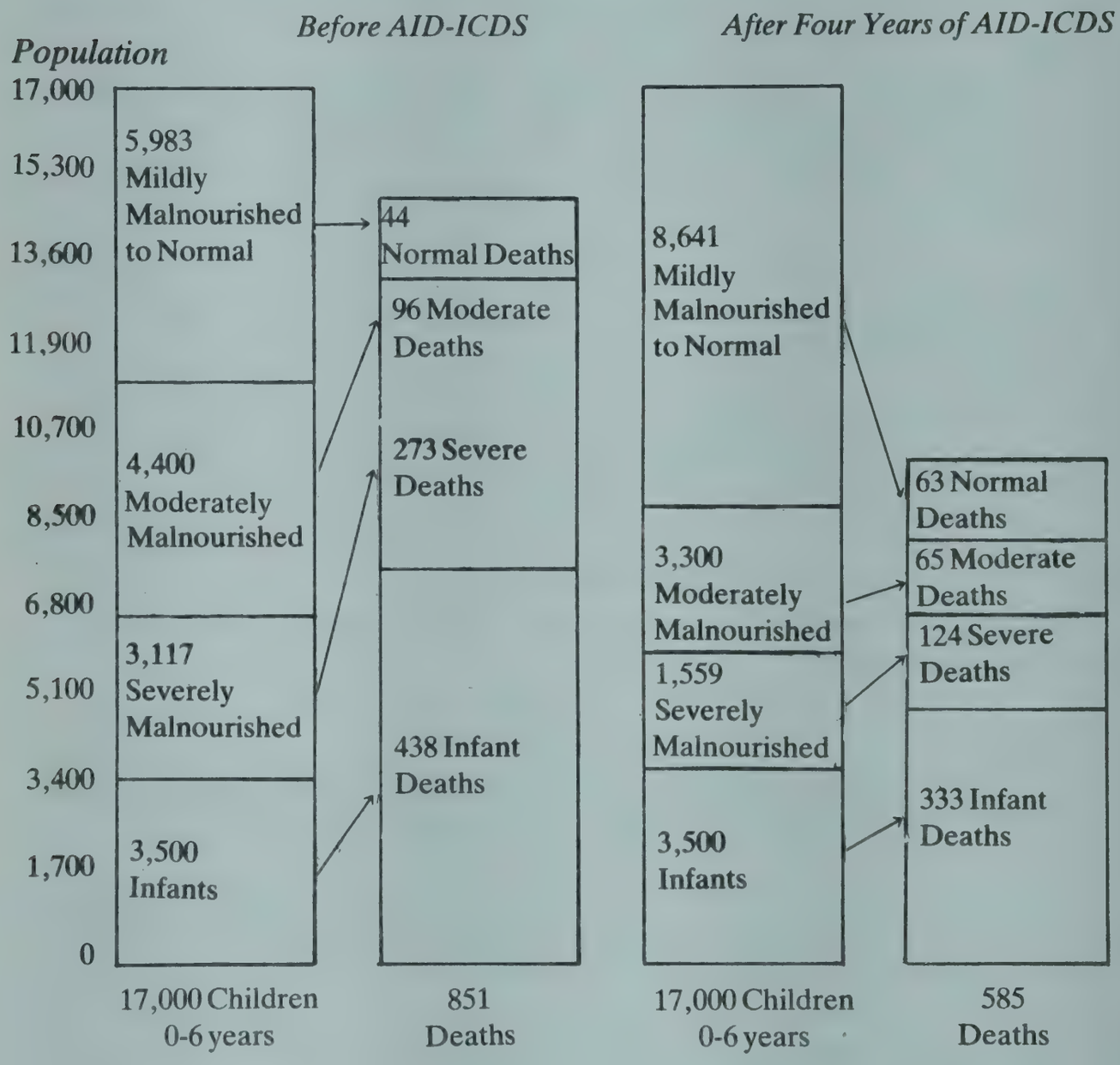
Expected Results of ICDS on Malnutrition and Mortality in One Block of 100,000 Population

	Before ICDS	*After 4 years of ICDS*
Population		
Infants	3,500	3,500
Severely malnourished	3,117	1,559
Moderately malnourished	4,400	3,300
Mildly malnourished to normal	5,983	8,641
Total (0–6 years)	17,000	17,000
Deaths		
Infants	438	333
Severely malnourished	273	124
Moderately malnourished	96	65
Mildly malnourished to normal	44	63
Total (0–6 years)	851	585

SOURCE: Makinen, 1983[9]

FIGURE 1

Expected results of AID assisted ICDS on malnutrition and mortality in one block of 100,000 population



SOURCE: Makinen, 1983[9]

operation in a block and then rises again due to inflation. To meet this cost and earn a 10 per cent return on investment, the avoidance of malnutrition in childhood would have to raise future adult productivity by 10 per cent in the most favourable assumption (MFA) case and by 23 per cent in the least favourable assumption (LFA) case. To cover all costs of the project through 1989 ($202 per case averted) those who

TABLE 10

Costs and Expected Results of ICDS Implemented in a Rural Block with 147 Anganwadis

FY	*Food beneficiaries*	*Non-food*	*Costs ($000) Food + O.T.**	*Total*	*Cases of malnutrition averted*	*Deaths averted*
1984	13,818	97.7	139.2	236.9	565	130
1985	13,818	98.2	147.3	245.5	849	136
1986	13,818	100.8	164.9	265.7	1,131	182
1987	13,818	103,3	194.1	297.4	1,508	242
1988	13,818	105.9	213.5	319.4	1,696	273
1989	13,818	108.5	234.9	343.4	1,696	273

SOURCE: Makinen, 1983[9]

*Food costs include approximately 40 per cent of ocean transport.

TABLE 11

AID Assisted ICDS Cost per Malnutrition Case Avoided

FY	*Cost per case avoided ($)*
1984	419
1985	289
1986	235
1987	197
1988	188
1989	202

SOURCE: Makinen, 1983[9]

avoid malnutrition would have to increase their productivity by 15 per cent under the MFA and 33 per cent under the LFA. These rates are those needed on productivity growth alone.

Since there is no direct evidence as to what productivity increase may be expected it is necessary to see if increases of 10 to 33 per cent are within the order of magnitude that may be reasonably expected. A study by the National Institute of Nutrition, Hyderabad, (NIN, Annual Report, 1980) found significant (but unspecified) differences in wages paid to day labourers on the basis of physical size. Since adult size is an indication of childhood nutrition and size was used implicitly by employers as an indication of productivity, the linkage can be predicated that childhood nutritional status affects adult productivity. Numerous studies of childhood malnutrition have found that in deprived

TABLE 12

Earning Advancement Benefit from AID Assisted ICDS Implemented in an Average Rural Block

FY	*Deaths averted*		*($000)*	
	Infant	*Young child*	*Value of earnings advancement*	
			LFA	*MFA*
1984	57	69	25.2	40.0
1985	86	104	37.5	60.3
1986	114	138	50.0	80.3
1987	152	184	66.6	107.2
1988	172	207	74.9	120.5
1989	172	207	74.9	120.5

SOURCE: Makinen, 1983[9]

TABLE 13

Food Savings Benefits from ICDS Implemented in an Average Rural Block

FY	*Deaths averted*		*($000)*
	Infant	*Young child*	*Value of food saved*
1984	57	69	17.20
1985	86	104	25.81
1986	114	138	34.41
1987	152	184	45.90
1988	172	207	51.57
1989	172	207	51.57

SOURCE: Makinen, 1983[9]

Calculated from a study of IMR data in Rural North Arcot, presented in R. Puffer, Report to USAID/New Delhi, 1981.

communities, malnourished children show persistent significant differences from the well-nourished in cognitive functions, attention span, ability to concentrate and motivation into late childhood. None of these studies, however, make the link between childhood malnutrition, hence ability and later adult productivity. Selowsky[11] has used such study results along with studies showing the predictive power of childhood ability on adult ability, to show that a one standard deviation (S.D.) increase in childhood ability would increase lifetime earnings of persons with low educational attainment by 0.65 times. A two S.D. increase would improve earnings by 1.32 times. Selowsky goes on to show that persons with greater ability will seek more education, which further

improves earnings. Accounting for both the pure ability effect and the induced education effect, a one S.D. increase in ability implies a 2.32-fold improvement in lifetime earnings, and a two S.D. increase a 5.63-fold improvement. Thus it appears that the ICDS project could generate the necessary productivity increases to earn at least a 10 per cent return, if improvements in ability of one to two S.D. may be expected. Studies elsewhere on integrated programmes of feeding, pre-school education and health care similar to the ICDS have shown that improvements in the cognitive ability of participating malnourished children are well within this range.

There are two kinds of economic benefits that may be calculated for the reduction in child mortality: the present value of advanced earnings and the savings of wasted resources. The advanced earning benefit assumes that there is a desire for a target number of children in a family, so that, if one dies, she/he will be replaced by an additional birth. By preventing a death, the need to have an additional child is eliminated, with the result that the earnings stream of the surviving child is advanced by the number of years between his or her birth and the time at which the replacement would be born. The present value of the advancement is calculated as the benefit. Four years were taken as the period of earnings advancement. Using the same parameters as in the section on productivity, the advanced earnings benefit of a prevented infant death is $295 under MFA and $178 under LFA. For a young-child death averted the earnings advancement benefit ranges from $214 under LFA to $337 under MFA. The AID assisted ICDS project expects to reduce IMR from 136 to 102 and CMR from 30.6 to 20.0. The value of earnings advancement following from ICDS in an average rural block is shown in Table 12. When the block reaches full maturity in 1988 the earnings advancement benefit accounts for between 31 and 49 per cent of costs. Over the six year period 1984–89 this benefit accounts for 13 to 43 per cent of total costs.

Premature child deaths cause a waste of resources spent on child maintenance, i.e. expenditure on food and clothing up to the time of the child's death. The child-maintenance costs of early death may be evaluated. Since the deaths averted by the ICDS occur at very early ages, there is almost no spending on clothing to be lost. Therefore, our evaluation of child-maintenance costs will include only food losses. Most infant deaths occur in the immediate neonatal period (R. Puffer. Report to USAID/New Delhi, 1981), so that the average life-span of a child who dies in infancy is 77 days. Their daily food consumption will be estimated as 600 KCal; hence the loss is 46,200 KCal per death (Table 13).

The conclusion of Makinen's economic analysis was that the AID assisted ICDS project would earn more, and probably much more, than a 10 per cent return in investment. With that I will conclude this

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paper and hope that the examples of cost-effectiveness and cost-benefit analyses presented have made this grey area of programme design and evaluation less murky.

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Appendix I

ANTHROPOMETRY: PRINCIPLES AND METHODS

This appendix describes in detail the principles and methods of commonly used anthropometric measurements. The objective is to familiarize the students with the basic principles of anthropometry and help them to acquire skills in making the measurements correctly.

WEIGHT-FOR-AGE

Principle: Weight is a measurement of body mass. Weight deficiency appears to be the best indicator of the prevalence of protein-energy malnutrition in children of all age groups. Comparison of weight-for-age values with regional standards at corresponding ages will help determine the degree of underweight in a community. It is important that the age of the subjects is correctly known and the presence of pathological weight (e.g. due to oedema) is ruled out.

Methodology: For obtaining accurate body weights of young children, the Salter scale is the most convenient. The Salter scale should preferably be calibrated to read to the nearest 100 g. It should be hung freely from a hook along with the trousers. The needle/pointer is brought to zero by adjusting the screw. The child is placed in the trousers with the minimum of clothing on, and the weight is read to the nearest 0.1 kg.

For weighing older children an adult platform weighing balance (also known as a personal weighing scale) can be used as it is portable and convenient to use in the field. The weighing scale should be checked for accuracy against a Libra-Detecto weight-cum-height meter, and should also be periodically checked with a 10 kg weight after weighing every 10th child. The scale should be adjusted to zero before each measurement. The subject should have minimum clothing on and should be asked to stand on the platform of the scale, without touching anything, and looking straight ahead. His weight should be recorded to the nearest 0.25 kg.

HEIGHT-FOR-AGE

Principle: Height is a linear measurement made up of the sum of four components: legs, pelvis, spine and skull. The extent of height deficit in relation to age, as compared to regional standards, may be regarded as a measure of the duration of malnutrition. A given deficit in height may represent a short period of growth failure at an early age or a longer period of growth failure at a later age.

Methodology: A measuring tape should be fixed vertically on a smooth wall perpendicular to the ground, taking care to see that the floor area is even and not rough. The subject is asked to remove his shoes, stand with the centre of his back touching the scale, with his feet parallel and heels, buttocks, shoulders and back of the head touching the wall. The head should be held comfortably erect; the arms should hang loosely by the side. A smooth, thin ruler is held on top of the head in the centre, crushing the hair at a right angle to the scale, and the height read off from the lower edge of the ruler to the nearest 0.5 cm. Each reading should be taken twice to ensure correctness of the measurement.

WEIGHT-FOR HEIGHT

Principle: A major difficulty with weight-for-age is that in many communities the precise ages of children are unknown. Further, weight measurements should also be evaluated in terms of height of the subject to be meaningful. Weight for a given height is age-independent or nearly so. An age effect of the relationship between weight and height becomes apparent only at the extremes of the range—in children who are very tall or very short for their age. Thus, standards of expected weight at a given height, constructed from a presumably well-nourished population, are essentially age-independent. Weight-for-height is an index of current nutritional status, height-for-age gives a picture of past nutritional history.

Methodology: The weight of each subject for his height should be compared with the standard weight at the same height. The percentage of subjects falling in different categories of nutritional grading is calculated.

MID-UPPER-ARM-CIRCUMFERENCE FOR AGE

Principle: Muscle and fat constitute the soft tissues that vary with a deficiency of protein and calories. Measurement of the mid-upper-arm-circumference is the most useful, practical method for assessing muscle mass, as this region is easily accessible and measurement requires only a flexible fibreglass tape.

Methodology: The subject should be asked to flex his left arm at the elbow such that the lower arm should be at a right angle to the upper arm. The length between the acromion process of the scapula and olecranon process of the ulna should be measured with a flexible fibreglass tape and the site of measurement, exactly midway down the upper arm, should be marked with a pen. The subject should then be asked to hang his arm relaxed by the side and the tape passed gently, but firmly, around the arm at the selected mid-point, taking care to avoid compression of the soft tissues of the arm. The arm circumference should be measured to the nearest 0.1 cm. Each measurement should be made twice to ensure accuracy.

SKINFOLD AT TRICEPS

Principle: Measurement of skinfold (or fat fold) at triceps is one of the methods for assessment of the amount of subcutaneous fat, which gives an indication of the calorie reserves in the body.

Methodology: The same site selected for measuring mid-upper-arm-circumference should be used, midway down the length of the left upper arm. With the arm hanging relaxed at the side, the skinfold parallel to the long axis should be picked up between the thumb and forefinger, well away from the underlying muscle, and the skinfold measured to the nearest 0.1 mm by means of the Harpenden calipers. The dial of the calipers should be checked each day and re-set to zero if necessary. Each measurement should be done twice to ensure accuracy.

Appendix II

ANTHROPOMETRIC STANDARDS

The anthropometric standards currently available as reference standards are included here. The international standards include the height and weight standards for the 0–36 month old children compiled from studies at the Fels Research Institute, Yellow Springs, Ohio and the height and weight standards of 2–18 year old children from national samples of the National Center for Health Statistics, USA (NCHS). The mid-upper-arm-circumference data are for the all-white subjects in the US Health and Nutrition Examination Survey I, 1971–1974 (HANE-I, USA).

The reference standards for Indian children from 0–10 years are from the 10-year cohort study of well-nourished Indian children by Shanti Ghosh, and for the 5–18 year age group are from studies carried out on Indian public school children by Vijayaraghavan, Darshan Singh and Swaminathan of the National Institute of Nutrition, Hyderabad.

Appendix II(A)

NCHS STANDARDS*

*SOURCE: Measuring Changes in Nutritional Status, Geneva, 1983 World Health Organization.

TABLE 1

Length (cm) by Age of Boys aged 0–36 months

Age Months	Centiles													Standard deviations							Age Months
	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	
0	46.2	46.7	47.6	48.6	49.3	49.9	50.5	51.1	51.7	52.4	53.4	54.2	54.8	43.6	45.9	48.2	50.5	52.8	55.1	57.4	0
1	49.9	50.5	51.4	52.5	53.3	53.9	54.6	55.2	55.9	56.6	57.7	58.6	59.2	47.2	49.7	52.1	54.6	57.0	59.5	61.9	1
2	53.2	53.9	54.8	55.9	56.7	57.4	58.1	58.7	59.4	60.2	61.4	62.3	62.9	50.4	52.9	55.5	58.1	60.7	63.2	65.8	2
3	56.1	56.8	57.7	58.9	59.7	60.4	61.1	61.8	62.5	63.3	64.5	65.5	66.1	53.2	55.8	58.5	61.1	63.7	66.4	69.0	3
4	58.6	59.3	60.3	61.4	62.3	63.0	63.7	64.4	65.1	66.0	67.1	68.1	68.7	55.6	58.3	61.0	63.7	66.4	69.1	71.7	4
5	60.8	61.5	62.5	63.6	64.5	65.2	65.9	66.6	67.3	68.2	69.4	70.3	71.0	57.8	60.5	63.2	65.9	68.6	71.3	74.0	5
6	62.8	63.4	64.4	65.6	66.4	67.1	67.8	68.5	69.2	70.1	71.3	72.2	72.9	59.8	62.4	65.1	67.8	70.5	73.2	75.9	6
7	64.5	65.1	66.1	67.2	68.1	68.8	69.5	70.2	70.9	71.7	72.9	73.9	74.5	61.5	64.1	66.8	69.5	72.2	74.8	77.5	7
8	66.0	66.6	67.6	68.7	69.6	70.3	71.0	71.6	72.4	73.2	74.4	75.3	76.0	63.0	65.7	68.3	71.0	73.6	76.3	78.9	8
9	67.4	68.0	68.9	70.1	70.9	71.7	72.3	73.0	73.7	74.6	75.7	76.7	77.3	64.4	67.0	69.7	72.3	75.0	77.6	80.3	9
10	68.7	69.3	70.2	71.4	72.2	73.0	73.6	74.3	75.0	75.9	77.0	78.0	78.6	65.7	68.3	71.0	73.6	76.3	78.9	81.6	10
11	69.9	70.5	71.5	72.6	73.5	74.2	74.9	75.6	76.3	77.1	78.3	79.3	79.9	66.9	69.6	72.2	74.9	77.5	80.2	82.9	11
12	71.0	71.6	72.6	73.8	74.7	75.4	76.1	76.8	77.5	78.4	79.5	80.5	81.2	68.0	70.7	73.4	76.1	78.8	81.5	84.2	12
13	72.1	72.7	73.7	74.9	75.8	76.5	77.2	77.9	78.7	79.5	80.7	81.7	82.4	69.0	71.8	74.5	77.2	80.0	82.7	85.5	13
14	73.1	73.8	74.8	76.0	76.9	77.6	78.3	79.1	79.8	80.7	81.9	82.9	83.6	70.0	72.8	75.6	78.3	81.1	83.9	86.7	14
15	74.1	74.7	75.8	77.0	77.9	78.7	79.4	80.1	80.9	81.8	83.1	84.1	84.8	70.9	73.7	76.6	79.4	82.3	85.1	88.0	15
16	75.0	75.7	76.7	78.0	78.9	79.7	80.4	81.2	82.0	82.9	84.2	85.2	85.9	71.7	74.6	77.5	80.4	83.4	86.3	89.2	16
17	75.9	76.6	77.6	78.9	79.9	80.7	81.4	82.2	83.0	83.9	85.3	86.3	87.0	72.5	75.5	78.5	81.4	84.4	87.4	90.4	17
18	76.7	77.4	78.5	79.8	80.8	81.6	82.4	83.2	84.0	85.0	86.3	87.4	88.1	73.3	76.3	79.4	82.4	85.4	88.5	91.5	18

TABLE 1—*Continued*

Age Months	Centiles													Standard deviations							Age Months
	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	
19	77.5	78.2	79.4	80.7	81.7	82.6	83.3	84.1	85.0	86.0	87.3	88.4	89.2	74.0	77.1	80.2	83.3	86.4	89.5	92.7	19
20	78.3	79.0	80.2	81.6	82.6	83.4	84.2	85.0	85.9	86.9	88.3	89.5	90.2	74.7	77.9	81.1	84.2	87.4	90.6	93.8	20
21	79.1	79.8	81.0	82.4	83.4	84.3	85.1	85.9	86.8	87.8	89.3	90.4	91.2	75.4	78.7	81.9	85.1	88.4	91.6	94.8	21
22	79.8	80.6	81.8	83.2	84.3	85.2	86.0	86.8	87.7	88.7	90.2	91.4	92.2	76.1	79.4	82.7	86.0	89.3	92.5	95.8	22
23	80.6	81.3	82.6	84.0	85.1	86.0	86.8	87.7	88.6	89.6	91.1	92.3	93.1	76.8	80.2	83.5	86.8	90.2	93.5	96.8	23
24	81.3	82.1	83.3	84.8	85.9	86.8	87.6	88.5	89.4	90.5	92.0	93.2	94.0	77.5	80.9	84.3	87.6	91.0	94.4	97.7	24
25	82.1	82.9	84.1	85.6	86.7	87.6	88.5	89.3	90.2	91.3	92.8	94.0	94.8	78.3	81.7	85.1	88.5	91.8	95.2	98.6	25
26	82.8	83.6	84.9	86.4	87.5	88.4	89.2	90.1	91.0	92.1	93.6	94.9	95.7	79.0	82.4	85.8	89.2	92.7	96.1	99.5	26
27	83.6	84.4	85.6	87.1	88.2	89.2	90.0	90.9	91.8	92.9	94.4	95.7	96.5	79.8	83.2	86.6	90.0	93.4	96.9	100.3	27
28	84.4	85.2	86.4	87.9	89.0	89.9	90.8	91.7	92.6	93.7	95.2	96.4	97.2	80.5	83.9	87.4	90.8	94.2	97.6	101.1	28
29	85.1	85.9	87.2	88.7	89.8	90.7	91.6	92.4	93.3	94.4	95.9	97.2	98.0	81.3	84.7	88.1	91.6	95.0	98.4	101.8	29
30	85.8	86.7	87.9	89.4	90.5	91.4	92.3	93.2	94.1	95.2	96.7	97.9	98.7	82.0	85.4	88.9	92.3	95.7	99.2	102.6	30
31	86.6	87.4	88.6	90.1	91.2	92.2	93.0	93.9	94.8	95.9	97.4	98.7	99.5	82.7	86.2	89.6	93.0	96.5	99.9	103.3	31
32	87.3	88.1	89.3	90.9	91.9	92.9	93.7	94.6	95.5	96.6	98.2	99.4	100.2	83.4	86.9	90.3	93.7	97.2	100.6	104.1	32
33	88.0	88.8	90.0	91.6	92.6	93.6	94.5	95.3	96.3	97.4	98.9	100.1	100.9	84.1	87.6	91.0	94.5	97.9	101.4	104.8	33
34	88.6	89.4	90.7	92.2	93.3	94.3	95.2	96.0	97.0	98.1	99.6	100.9	101.7	84.7	88.2	91.7	95.2	98.6	102.1	105.6	34
35	89.3	90.1	91.4	92.9	94.0	95.0	95.8	96.7	97.7	98.8	100.3	101.6	102.4	85.4	88.8	92.3	95.8	99.3	102.8	106.3	35
36	89.9	90.7	92.0	93.5	94.7	95.6	96.5	97.4	98.4	99.5	101.0	102.3	103.2	85.9	89.4	93.0	96.5	100.1	103.6	107.1	36

TABLE 2

Stature (cm) by Age of Boys aged 2–18 years

Age		Centiles												Standard deviations							Age	
Yrs	Mths	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	Yrs	Mths
2	0	79.6	80.4	81.5	82.9	83.9	84.8	85.6	86.4	87.3	88.3	89.7	90.8	91.6	76.0	79.2	82.4	85.6	88.8	92.0	95.2	2	0
2	1	80.3	81.1	82.3	83.7	84.7	85.6	86.4	87.2	88.1	89.2	90.6	91.8	92.5	76.7	79.9	83.2	86.4	89.7	92.9	96.2	2	1
2	2	81.0	81.8	83.0	84.5	85.5	86.4	87.2	88.1	89.0	90.0	91.5	92.7	93.5	77.3	80.6	83.9	87.2	90.6	93.9	97.2	2	2
2	3	81.7	82.5	83.8	85.2	86.3	87.2	88.1	88.9	89.8	90.9	92.4	93.6	94.4	78.0	81.3	84.7	88.1	91.4	94.8	98.1	2	3
2	4	82.4	83.2	84.5	86.0	87.1	88.0	88.9	89.7	90.7	91.7	93.2	94.5	95.3	78.6	82.0	85.4	88.9	92.3	95.7	99.1	2	4
2	5	83.1	83.9	85.2	86.7	87.8	88.8	89.7	90.5	91.5	92.6	94.1	95.4	96.2	79.2	82.7	86.2	89.7	93.1	96.6	100.1	2	5
2	6	83.8	84.6	85.9	87.5	88.6	89.5	90.4	91.3	92.3	93.4	94.9	96.2	97.1	79.9	83.4	86.9	90.4	94.0	97.5	101.0	2	6
2	7	84.5	85.3	86.6	88.2	89.3	90.3	91.2	92.1	93.1	94.2	95.8	97.1	97.9	80.5	84.1	87.6	91.2	94.8	98.3	101.9	2	7
2	8	85.2	86.0	87.3	88.9	90.1	91.0	92.0	92.9	93.9	95.0	96.6	97.9	98.8	81.1	84.7	88.3	92.0	95.6	99.2	102.8	2	8
2	9	85.8	86.7	88.0	89.6	90.8	91.8	92.7	93.6	94.6	95.8	97.4	98.8	99.6	81.7	85.4	89.0	92.7	96.4	100.1	103.7	2	9
2	10	86.5	87.3	88.7	90.3	91.5	92.5	93.5	94.4	95.4	96.6	98.2	99.6	100.5	82.3	86.0	89.7	93.5	97.2	100.9	104.6	2	10
2	11	87.1	88.0	89.4	91.0	92.2	93.2	94.2	95.1	96.2	97.4	99.0	100.4	101.3	82.9	86.7	90.4	94.2	98.0	101.7	105.5	2	11
3	0	87.8	88.7	90.0	91.7	92.9	94.0	94.9	95.9	96.9	98.1	99.8	101.2	102.1	83.5	87.3	91.1	94.9	98.7	102.5	106.3	3	0
3	1	88.4	89.3	90.7	92.4	93.6	94.7	95.6	96.6	97.7	98.9	100.6	102.0	102.9	84.1	87.9	91.8	95.6	99.5	103.3	107.2	3	1
3	2	89.0	89.9	91.3	93.1	94.3	95.4	96.3	97.3	98.4	99.6	101.3	102.7	103.7	84.7	88.6	92.4	96.3	100.2	104.1	108.0	3	2
3	3	89.6	90.6	92.0	93.7	95.0	96.0	97.0	98.0	99.1	100.4	102.1	103.5	104.4	85.2	89.2	93.1	97.0	101.0	104.9	108.8	3	3
3	4	90.2	91.2	92.6	94.4	95.6	96.7	97.7	98.7	99.8	101.1	102.8	104.3	105.2	85.8	89.8	93.8	97.7	101.7	105.7	109.7	3	4
3	5	90.9	91.8	93.3	95.0	96.3	97.4	98.4	99.4	100.5	101.8	103.6	105.0	106.0	86.4	90.4	94.4	98.4	102.4	106.4	110.5	3	5
3	6	91.5	92.4	93.9	95.7	97.0	98.1	99.1	100.1	101.2	102.5	104.3	105.7	106.7	86.9	91.0	95.0	99.1	103.1	107.2	111.2	3	6
3	7	92.0	93.0	94.5	96.3	97.6	98.7	99.7	100.8	101.9	103.2	105.0	106.5	107.4	87.5	91.6	95.7	99.7	103.8	107.9	112.0	3	7
3	8	92.6	93.6	95.1	96.9	98.2	99.4	100.4	101.4	102.6	103.9	105.7	107.2	108.2	88.0	92.1	96.3	100.4	104.5	108.7	112.8	3	8
3	9	93.2	94.2	95.7	97.5	98.9	100.0	101.0	102.1	103.2	104.6	106.4	107.9	108.9	88.6	92.7	96.9	101.0	105.2	109.4	113.5	3	9
3	10	93.8	94.8	96.3	98.2	99.5	100.6	101.7	102.8	103.9	105.2	107.1	108.6	109.6	89.1	93.3	97.5	101.7	105.9	110.1	114.3	3	10
3	11	94.4	95.4	96.9	98.8	100.1	101.3	102.3	103.4	104.5	105.9	107.7	109.3	110.3	89.6	93.9	98.1	102.3	106.6	110.8	115.0	3	11

TABLE 2—*Continued*

Age		Centiles												Standard deviations							Age	
Yrs	Mths	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	Yrs	Mths
4	0	94.9	95.9	97.5	99.4	100.7	101.9	102.9	104.0	105.2	106.5	108.4	110.0	111.0	90.2	94.4	98.7	102.9	107.2	111.5	115.7	4	0
4	1	95.5	96.5	98.1	100.0	101.3	102.5	103.6	104.7	105.8	107.2	109.1	110.6	111.6	90.7	95.0	99.3	103.6	107.9	112.2	116.5	4	1
4	2	96.0	97.1	98.6	100.5	101.9	103.1	104.2	105.3	106.4	107.8	109.7	111.3	112.3	91.2	95.5	99.9	104.2	108.5	112.8	117.2	4	2
4	3	96.6	97.6	99.2	101.1	102.5	103.7	104.8	105.9	107.1	108.4	110.4	111.9	113.0	91.7	96.1	100.4	104.8	109.1	113.5	117.8	4	3
4	4	97.1	98.2	99.8	101.7	103.1	104.3	105.4	106.5	107.7	109.1	111.0	112.6	113.6	92.2	96.6	101.0	105.4	109.8	114.2	118.5	4	4
4	5	97.7	98.7	100.3	102.3	103.7	104.9	106.0	107.1	108.3	109.7	111.6	113.2	114.3	92.7	97.1	101.6	106.0	110.4	114.8	119.2	4	5
4	6	98.2	99.2	100.9	102.8	104.2	105.4	106.6	107.7	108.9	110.3	112.2	113.9	114.9	93.2	97.7	102.1	106.6	111.0	115.4	119.9	4	6
4	7	98.7	99.8	101.4	103.4	104.8	106.0	107.1	108.3	109.5	110.9	112.9	114.5	115.5	93.7	98.2	102.7	107.1	111.6	116.1	120.5	4	7
4	8	99.2	100.3	101.9	103.9	105.3	106.6	107.7	108.8	110.1	111.5	113.5	115.1	116.2	94.2	98.7	103.2	107.7	112.2	116.7	121.2	4	8
4	9	99.8	100.8	102.5	104.5	105.9	107.1	108.3	109.4	110.6	112.1	114.1	115.7	116.8	94.7	99.2	103.7	108.3	112.8	117.3	121.8	4	9
4	10	100.3	101.3	103.0	105.0	106.4	107.7	108.8	110.0	111.2	112.7	114.7	116.3	117.4	95.2	99.7	104.3	108.8	113.4	117.9	122.5	4	10
4	11	100.8	101.9	103.5	105.5	107.0	108.2	109.4	110.5	111.8	113.2	115.2	116.9	118.0	95.7	100.2	104.8	109.4	114.0	118.5	123.1	4	11
5	0	101.3	102.4	104.0	106.1	107.5	108.8	109.9	111.1	112.3	113.8	115.8	117.5	118.6	96.1	100.7	105.3	109.9	114.5	119.1	123.7	5	0
5	1	101.8	102.9	104.5	106.6	108.0	109.3	110.5	111.6	112.9	114.4	116.4	118.1	119.2	96.6	101.2	105.8	110.5	115.1	119.7	124.3	5	1
5	2	102.3	103.4	105.1	107.1	108.6	109.8	111.0	112.2	113.4	114.9	117.0	118.6	119.7	97.1	101.7	106.4	111.0	115.6	120.3	124.9	5	2
5	3	102.8	103.9	105.6	107.6	109.1	110.4	111.5	112.7	114.0	115.5	117.5	119.2	120.3	97.5	102.2	106.9	111.5	116.2	120.9	125.5	5	3
5	4	103.2	104.3	106.0	108.1	109.6	110.9	112.1	113.2	114.5	116.0	118.1	119.8	120.9	98.0	102.7	107.4	112.1	116.8	121.4	126.1	5	4
5	5	103.7	104.8	106.5	108.6	110.1	111.4	112.6	113.8	115.1	116.5	118.6	120.3	121.4	98.4	103.2	107.9	112.6	117.3	122.0	126.7	5	5
5	6	104.2	105.3	107.0	109.1	110.6	111.9	113.1	114.3	115.6	117.1	119.2	120.9	122.0	98.9	103.6	108.4	113.1	117.8	122.6	127.3	5	6
5	7	104.7	105.8	107.5	109.6	111.1	112.4	113.6	114.8	116.1	117.6	119.7	121.4	122.6	99.3	104.1	108.9	113.6	118.4	123.1	127.9	5	7
5	8	105.1	106.3	108.0	110.1	111.6	112.9	114.1	115.3	116.6	118.1	120.2	122.0	123.1	99.8	104.6	109.3	114.1	118.9	123.7	128.4	5	8
5	9	105.6	106.7	108.5	110.6	112.1	113.4	114.6	115.8	117.1	118.7	120.8	122.5	123.6	100.2	105.0	109.8	114.6	119.4	124.2	129.0	5	9
5	10	106.0	107.2	108.9	111.1	112.6	113.9	115.1	116.3	117.6	119.2	121.3	123.0	124.2	100.7	105.5	110.3	115.1	119.9	124.7	129.6	5	10
5	11	106.5	107.6	109.4	111.5	113.1	114.4	115.6	116.8	118.1	119.7	121.8	123.6	124.7	101.1	105.9	110.8	115.6	120.4	125.3	130.1	5	11

Age		Centiles													Standard deviations							Age	
Yrs	Mths	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	Yrs	Mths
6	0	107.0	108.1	109.9	112.0	113.5	114.9	116.1	117.3	118.6	120.2	122.3	124.1	125.2	101.5	106.4	111.2	116.1	121.0	125.8	130.7	6	0
6	1	107.4	108.6	110.3	112.5	114.0	115.3	116.6	117.8	119.1	120.7	122.8	124.6	125.8	101.9	106.8	111.7	116.6	121.5	126.3	131.2	6	1
6	2	107.8	109.0	110.8	112.9	114.5	115.8	117.1	118.3	119.6	121.2	123.3	125.1	126.3	102.4	107.3	112.2	117.1	122.0	126.9	131.8	6	2
6	3	108.3	109.4	111.2	113.4	115.0	116.3	117.5	118.8	120.1	121.7	123.8	125.6	126.8	102.8	107.7	112.6	117.5	122.5	127.4	132.3	6	3
6	4	108.7	109.9	111.7	113.9	115.4	116.8	118.0	119.3	120.6	122.2	124.3	126.1	127.3	103.2	108.1	113.1	118.0	123.0	127.9	132.8	6	4
6	5	109.2	110.3	112.1	114.3	115.9	117.2	118.5	119.7	121.1	122.7	124.8	126.6	127.8	103.6	108.6	113.5	118.5	123.4	128.4	133.4	6	5
6	6	109.6	110.8	112.6	114.8	116.3	117.7	119.0	120.2	121.6	123.1	125.3	127.1	128.3	104.0	109.0	114.0	119.0	123.9	128.9	133.9	6	6
6	7	110.0	111.2	113.0	115.2	116.8	118.1	119.4	120.7	122.0	123.6	125.8	127.6	128.8	104.4	109.4	114.4	119.4	124.4	129.4	134.4	6	7
6	8	110.4	111.6	113.4	115.7	117.2	118.6	119.9	121.1	122.5	124.1	126.3	128.1	129.3	104.8	109.8	114.9	119.9	124.9	129.9	134.9	6	8
6	9	110.9	112.1	113.9	116.1	117.7	119.1	120.3	121.6	123.0	124.6	126.8	128.6	129.8	105.2	110.3	115.3	120.3	125.4	130.4	135.4	6	9
6	10	111.3	112.5	114.3	116.5	118.1	119.5	120.8	122.1	123.4	125.0	127.3	129.1	130.3	105.6	110.7	115.7	120.8	125.8	130.9	136.0	6	10
6	11	111.7	112.9	114.7	117.0	118.6	120..0	121.2	122.5	123.9	125.5	127.7	129.6	130.8	106.0	111.1	116.2	121.2	126.3	131.4	136.5	6	11
7	0	112.1	113.3	115.2	117.4	119.0	120.4	121.7	123.0	124.4	126.0	128.2	130.1	131.3	106.4	111.5	116.6	121.7	126.8	131.9	137.0	7	0
7	1	112.5	113.7	115.6	117.8	119.5	120.8	122.1	123.4	124.8	126.4	128.7	130.6	131.8	106.8	111.9	117.0	122.1	127.3	132.4	137.5	7	1
7	2	112.9	114.1	116.0	118.3	119.9	121.3	122.6	123.9	125.3	126.9	129.2	131.0	132.3	107.2	112.3	117.5	122.6	127.7	132.9	138.0	7	2
7	3	113.3	114.6	116.4	118.7	120.3	121.7	123.0	124.3	125.7	127.4	129.6	131.5	132.7	107.6	112.7	117.9	123.0	128.2	133.3	138.5	7	3
7	4	113.7	115.0	116.8	119.1	120.8	122.2	123.5	124.8	126.2	127.8	130.1	132.0	133.2	108.0	113.1	118.3	123.5	128.7	133.8	139.0	7	4
7	5	114.1	115.4	117.3	119.5	121.2	122.6	123.9	125.2	126.6	128.3	130.6	132.5	133.7	108.3	113.5	118.7	123.9	129.1	134.3	139.5	7	5
7	6	114.5	115.8	117.7	120.0	121.6	123.0	124.4	125.7	127.1	128.8	131.0	132.9	134.2	108.7	113.9	119.1	124.4	129.6	134.8	140.0	7	6
7	7	114.9	116.2	118.1	120.4	122.0	123.5	124.8	126.1	127.5	129.2	131.5	133.4	134.7	109.1	114.3	119.6	124.8	130.0	135.3	140.5	7	7
7	8	115.3	116.6	118.5	120.8	122.5	123.9	125.2	126.6	128.0	129.7	132.0	133.9	135.1	109.5	114.7	120.0	125.2	130.5	135.8	141.0	7	8
7	9	115.7	117.0	118.9	121.2	122.9	124.3	125.7	127.0	128.4	130.1	132.4	134.4	135.6	109.8	115.1	120.4	125.7	131.0	136.2	141.5	7	9
7	10	116.1	117.4	119.3	121.6	123.3	124.8	126.1	127.4	128.9	130.6	132.9	134.8	136.1	110.2	115.5	120.8	126.1	131.4	136.7	142.0	7	10
7	11	116.5	117.8	119.7	122.1	123.7	125.2	126.5	127.9	129.3	131.0	133.4	135.3	136.6	110.6	115.9	121.2	126.5	131.9	137.2	142.5	7	11

TABLE 2—*Continued*

Age		Centiles												Standard deviations							Age	
Yrs.	Mths	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D	Yrs	Mths
8	0	116.9	118.2	120.1	122.5	124.2	125.6	127.0	128.3	129.8	131.5	133.8	135.8	137.0	110.9	116.3	121.6	127.0	132.3	137.7	143.0	8	0
8	1	117.3	118.6	120.5	122.9	124.6	126.0	127.4	128.8	130.2	131.9	134.3	136.2	137.5	111.3	116.7	122.0	127.4	132.8	138.2	143.5	8	1
8	2	117.7	119.0	120.9	123.3	125.0	126.5	127.8	129.2	130.7	132.4	134.8	136.7	138.0	111.6	117.0	122.4	127.8	133.2	138.6	144.0	8	2
8	3	118.1	119.3	121.3	123.7	125.4	126.9	128.3	129.6	131.1	132.8	135.2	137.2	138.5	112.0	117.4	122.8	128.3	133.7	139.1	144.5	8	3
8	4	118.4	119.7	121.7	124.1	125.8	127.3	128.7	130.1	131.6	133.3	135.7	137.7	139.0	112.4	117.8	123.2	128.7	134.1	139.6	145.0	8	4
8	5	118.8	120.1	122.1	124.5	126.3	127.7	129.1	130.5	132.0	133.7	136.1	138.1	139.4	112.7	118.2	123.7	129.1	134.6	140.1	145.6	8	5
8	6	119.2	120.5	122.5	124.9	126.7	128.2	129.6	131.0	132.4	134.2	136.6	138.6	139.9	113.1	118.6	124.1	129.6	135.1	140.6	146.1	8	6
8	7	119.6	120.9	122.9	125.3	127.1	128.6	130.0	131.4	132.9	134.6	137.1	139.1	140.4	113.4	118.9	124.5	130.0	135.5	141.1	146.6	8	7
8	8	120.0	121.3	123.3	125.7	127.5	129.0	130.4	131.8	133.3	135.1	137.5	139.6	140.9	113.8	119.3	124.9	130.4	136.0	141.5	147.1	8	8
8	9	120.4	121.7	123.7	126.2	127.9	129.4	130.9	132.3	133.8	135.6	138.0	140.0	141.4	114.1	119.7	125.3	130.9	136.4	142.0	147.6	8	9
8	10	120.7	122.1	124.1	126.6	128.3	129.9	131.3	132.7	134.2	136.0	138.5	140.5	141.9	114.5	120.1	125.7	131.3	136.9	142.5	148.1	8	10
8	11	121.1	122.4	124.5	127.0	128.8	130.3	131.7	133.2	134.7	136.5	139.0	141.0	142.3	114.8	120.4	126.1	131.7	137.4	143.0	148.7	8	11
9	0	121.5	122.8	124.9	127.4	129.2	130.7	132.2	133.6	135.1	136.9	139.4	141.5	142.8	115.1	120.8	126.5	132.2	137.8	143.5	149.2	9	0
9	1	121.9	123.2	125.3	127.8	129.6	131.2	132.6	134.0	135.6	137.4	139.9	142.0	143.3	115.5	121.2	126.9	132.6	138.3	144.0	149.7	9	1
9	2	122.2	123.6	125.7	128.2	130.0	131.6	133.0	134.5	136.0	137.9	140.4	142.5	143.8	115.8	121.6	127.3	133.0	138.8	144.5	150.3	9	2
9	3	122.6	124.0	126.1	128.6	130.5	132.0	133.5	134.9	136.5	138.3	140.9	143.0	144.3	116.2	121.9	127.7	133.5	139.2	145.0	150.8	9	3
9	4	123.0	124.4	126.5	129.0	130.9	132.4	133.9	135.4	137.0	138.8	141.4	143.5	144.8	116.5	122.3	128.1	133.9	139.7	145.5	151.3	9	4
9	5	123.4	124.8	126.9	129.4	131.3	132.9	134.4	135.8	137.4	139.3	141.8	144.0	145.3	116.8	122.7	128.5	134.4	140.2	146.0	151.9	9	5
9	6	123.7	125.1	127.3	129.9	131.7	133.3	134.8	136.3	137.9	139.8	142.3	144.5	145.9	117.2	123.1	128.9	134.8	140.7	146.6	152.4	9	6
9	7	124.1	125.5	127.7	130.3	132.1	133.8	135.3	136.7	138.4	140.2	142.8	145.0	146.4	117.5	123.4	129.3	135.3	141.2	147.1	153.0	9	7
9	8	124.5	125.9	128.1	130.7	132.6	134.2	135.7	137.2	138.8	140.7	143.3	145.5	146.9	117.8	123.8	129.7	135.7	141.6	147.6	153.5	9	8
9	9	124.9	126.3	128.5	131.1	133.0	134.6	136.1	137.7	139.3	141.2	143.8	146.0	147.4	118.2	124.2	130.2	136.1	142.1	148.1	154.1	9	9
9	10	125.3	126.7	128.9	131.5	133.4	135.1	136.6	138.1	139.8	141.7	144.3	146.5	147.9	118.5	124.5	130.6	136.6	142.6	148.7	154.7	9	10
9	11	125.6	127.1	129.3	131.9	133.9	135.5	137.1	138.6	140.2	142.2	144.8	147.0	148.5	118.8	124.9	131.0	137.1	143.1	149.2	155.3	9	11

TABLE 2—*Continued*

Age		Centiles												Standard deviations							Age	
Yrs	Mths	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	Yrs	Mths
10	0	126.0	127.5	129.7	132.4	134.3	136.0	137.5	139.1	140.7	142.7	145.3	147.6	149.0	119.2	125.3	131.4	137.5	143.6	149.7	155.9	10	0
10	1	126.4	127.9	130.1	132.8	134.7	136.4	138.0	139.5	141.2	143.2	145.9	148.1	149.6	119.5	125.7	131.8	138.0	144.1	150.3	156.4	10	1
10	2	126.8	128.2	130.5	133.2	135.2	136.9	138.4	140.0	141.7	143.7	146.4	148.6	150.1	119.8	126.0	132.2	138.4	144.6	150.8	157.0	10	2
10	3	127.2	128.6	130.9	133.7	135.6	137.3	138.9	140.5	142.2	144.2	146.9	149.2	150.7	120.2	126.4	132.7	138.9	145.2	151.4	157.6	10	3
10	4	127.5	129.0	131.3	134.1	136.1	137.8	139.4	141.0	142.7	144.7	147.4	149.7	151.2	120.5	126.8	133.1	139.4	145.7	152.0	158.3	10	4
10	5	127.9	129.4	131.7	134.5	136.5	138.2	139.9	141.5	143.2	145.2	148.0	150.3	151.8	120.8	127.2	133.5	139.9	146.2	152.5	158.9	10	5
10	6	128.3	129.8	132.1	135.0	137.0	138.7	140.3	141.9	143.7	145.7	148.5	150.8	152.3	121.2	127.6	133.9	140.3	146.7	153.1	159.5	10	6
10	7	128.7	130.2	132.6	135.4	137.4	139.2	140.8	142.4	144.2	146.2	149.1	151.4	152.9	121.5	127.9	134.4	140.8	147.2	153.7	160.1	10	7
10	8	129.1	130.6	133.0	135.8	137.9	139.6	141.3	142.9	144.7	146.8	149.6	152.0	153.5	121.8	128.3	134.8	141.3	147.8	154.3	160.8	10	8
10	9	129.5	131.0	133.4	136.3	138.3	140.1	141.8	143.4	145.2	147.3	150.2	152.5	154.1	122.2	128.7	135.2	141.8	148.3	154.9	161.4	10	9
10	10	129.9	131.4	133.8	136.7	138.8	140.6	142.3	143.9	145.7	147.8	150.7	153.1	154.7	122.5	129.1	135.7	142.3	148.9	155.5	162.1	10	10
10	11	130.3	131.8	134.2	137.2	139.3	141.1	142.8	144.5	146.3	148.4	151.3	153.7	155.3	122.8	129.5	136.1	142.8	149.4	156.1	162.7	10	11
11	0	130.6	132.2	134.7	137.6	139.8	141.6	143.3	145.0	146.8	148.9	151.9	154.3	155.9	123.1	129.9	136.6	143.3	150.0	156.7	163.4	11	0
11	1	131.0	132.6	135.1	138.1	140.2	142.1	143.8	145.5	147.3	149.5	152.5	154.9	156.5	123.5	130.2	137.0	143.8	150.5	157.3	164.1	11	1
11	2	131.4	133.1	135.5	138.5	140.7	142.6	144.3	146.0	147.9	150.0	153.0	155.5	157.1	123.8	130.6	137.5	144.3	151.1	157.9	164.8	11	2
11	3	131.8	133.5	136.0	139.0	141.2	143.1	144.8	146.5	148.4	150.6	153.6	156.1	157.8	124.1	131.0	137.9	144.8	151.7	158.6	165.5	11	3
11	4	132.2	133.9	136.4	139.5	141.7	143.6	145.3	147.1	149.0	151.2	154.2	156.8	158.4	124.5	131.4	138.4	145.3	152.3	159.2	166.2	11	4
11	5	132.6	134.3	136.8	139.9	142.2	144.1	145.8	147.6	149.5	151.8	154.8	157.4	159.0	124.8	131.8	138.8	145.8	152.9	159.9	166.9	11	5
11	6	133.0	134.7	137.3	140.4	142.7	144.6	146.4	148.2	150.1	152.3	155.5	158.0	159.7	125.1	132.2	139.3	146.4	153.5	160.5	167.6	11	6
11	7	133.5	135.1	137.7	140.9	143.2	145.1	146.9	148.7	150.7	152.9	156.1	158.7	160.4	125.5	132.6	139.8	146.9	154.1	161.2	168.4	11	7
11	8	133.9	135.6	138.2	141.4	143.7	145.6	147.4	149.3	151.2	153.5	156.7	159.3	161.0	125.8	133.0	140.2	147.4	154.7	161.9	169.1	11	8
11	9	134.3	136.0	138.6	141.9	144.2	146.1	148.0	149.8	151.8	154.1	157.3	160.0	161.7	126.1	133.4	140.7	148.0	155.3	162.6	169.9	11	9
11	10	134.7	136.4	139.1	142.3	144.7	146.7	148.5	150.4	152.4	154.7	158.0	160.7	162.4	126.5	133.8	141.2	148.5	155.9	163.3	170.6	11	10
11	11	135.1	136.9	139.6	142.8	145.2	147.2	149.1	151.0	153.0	155.4	158.6	161.3	163.1	126.8	134.2	141.7	149.1	156.5	164.0	171.4	11	11

TABLE 2—*Continued*

Age		Centiles												Standard deviations							Age	
Yrs	*Mths*	*3rd*	*5th*	*10th*	*20th*	*30th*	*40th*	*50th*	*60th*	*70th*	*80th*	*90th*	*95th*	*97th*	*−3S.D.*	*−2S.D.*	*−1S.D.*	*MEDIAN*	*+1S.D.*	*+2S.D.*	*+3S.D.*	*Yrs*	*Mths*
12	0	135.5	137.3	140.0	143.3	145.7	147.8	149.7	151.6	153.6	156.0	159.3	162.0	163.8	127.1	134.6	142.1	149.7	157.2	164.7	172.2	12	0
12	1	136.0	137.7	140.5	143.8	146.2	148.3	150.2	152.1	154.2	156.6	159.9	162.7	164.5	127.5	135.1	142.6	150.2	157.8	165.4	172.9	12	1
12	2	136.4	138.2	141.0	144.3	146.8	148.8	150.8	152.7	154.8	157.2	160.6	163.4	165.2	127.8	135.5	143.1	150.8	158.4	166.1	173.7	12	2
12	3	136.8	138.6	141.4	144.8	147.3	149.4	151.3	153.3	155.4	157.8	161.2	164.0	165.9	128.2	135.9	143.6	151.3	159.1	166.8	174.5	12	3
12	4	137.3	139.1	141.9	145.3	147.8	149.9	151.9	153.9	156.0	158.5	161.9	164.7	166.6	128.5	136.3	144.1	151.9	159.7	167.5	175.3	12	4
12	5	137.7	139.5	142.4	145.9	148.4	150.5	152.5	154.5	156.6	159.1	162.5	165.4	167.3	128.9	136.8	144.6	152.5	160.3	168.2	176.0	12	5
12	6	138.1	140.0	142.9	146.4	148.9	151.0	153.0	155.0	157.2	159.7	163.2	166.1	167.9	129.3	137.2	145.1	153.0	161.0	168.9	176.8	12	6
12	7	138.6	140.5	143.4	146.9	149.4	151.6	153.6	155.6	157.8	160.3	163.9	166.8	168.6	129.6	137.6	145.6	153.6	161.6	169.6	177.6	12	7
12	8	139.0	140.9	143.9	147.4	150.0	152.1	154.2	156.2	158.4	161.0	164.5	167.4	169.3	130.0	138.1	146.1	154.2	162.2	170.3	178.3	12	8
12	9	139.5	141.4	144.4	147.9	150.5	152.7	154.8	156.8	159.0	161.6	165.2	168.1	170.0	130.4	138.5	146.6	154.8	162.9	171.0	179.1	12	9
12	10	140.0	141.9	144.9	148.4	151.0	153.3	155.3	157.4	159.6	162.2	165.8	168.8	170.7	130.8	139.0	147.2	155.3	163.5	171.7	179.8	12	10
12	11	140.4	142.4	145.4	149.0	151.6	153.8	155.9	158.0	160.2	162.8	166.4	169.4	171.4	131.2	139.4	147.7	155.9	164.1	172.4	180.6	12	11
13	0	140.9	142.9	145.9	149.5	152.1	154.4	156.5	158.6	160.8	163.4	167.1	170.1	172.0	131.6	139.9	148.2	156.5	164.7	173.0	181.3	13	0
13	1	141.4	143.3	146.4	150.0	152.7	154.9	157.0	159.1	161.4	164.0	167.7	170.7	172.7	132.1	140.4	148.7	157.0	165.4	173.7	182.0	13	1
13	2	141.9	143.8	146.9	150.6	153.2	155.5	157.6	159.7	162.0	164.7	168.3	171.4	173.4	132.5	140.9	149.2	157.6	166.0	174.4	182.7	13	2
13	3	142.3	144.3	147.4	151.1	153.8	156.0	158.2	160.3	162.6	165.3	169.0	172.0	174.0	132.9	141.3	149.8	158.2	166.6	175.0	183.4	13	3
13	4	142.8	144.8	147.9	151.6	154.3	156.6	158.7	160.9	163.2	165.9	169.6	172.6	174.6	133.4	141.8	150.3	158.7	167.2	175.6	184.1	13	4
13	5	143.3	145.3	148.4	152.2	154.8	157.1	159.3	161.4	163.7	166.4	170.2	173.3	175.3	133.8	142.3	150.8	159.3	167.8	176.3	184.8	13	5
13	6	143.8	145.9	148.9	152.7	155.4	157.7	159.9	162.0	164.3	167.0	170.8	173.9	175.9	134.3	142.8	151.3	159.9	168.4	176.9	185.4	13	6
13	7	144.4	146.4	149.5	153.2	155.9	158.2	160.4	162.6	164.9	167.6	171.4	174.5	176.5	134.8	143.3	151.9	160.4	168.9	177.5	186.0	13	7
13	8	144.9	146.9	150.0	153.8	156.5	158.8	161.0	163.1	165.4	168.2	171.9	175.0	177.1	135.3	143.9	152.4	161.0	169.5	178.1	186.6	13	8
13	9	145.4	147.4	150.5	154.3	157.0	159.3	168.5	163.7	166.0	168.7	172.5	175.6	177.6	135.8	144.4	152.9	161.5	170.1	178.6	187.2	13	9
13	10	145.9	148.0	151.1	154.8	157.6	159.9	162.1	164.2	166.5	169.3	173.0	176.1	178.2	136.3	144.9	153.5	162.1	170.6	179.2	187.8	13	10
13	11	146.5	148.5	151.6	155.4	158.1	160.4	162.6	164.8	167.1	169.8	173.6	176.7	178.7	136.9	145.4	154.0	162.6	171.2	179.7	188.3	13	11

TABLE 2—*Continued*

Age		Centiles												Standard deviations							Age	
Yrs	Mths	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	Yrs	Mths
14	0	147.0	149.0	152.1	155.9	158.6	161.0	163.1	165.3	167.6	170.3	174.1	177.2	179.2	137.4	146.0	154.6	163.1	171.7	180.2	188.8	14	0
14	1	147.6	149.6	152.7	156.5	159.2	161.5	163.6	165.8	168.1	170.8	174.6	177.7	179.7	138.0	146.5	155.1	163.6	172.2	180.8	189.3	14	1
14	2	148.1	150.1	153.2	157.0	159.7	162.0	164.2	166.3	168.6	171.4	175.1	178.2	180.2	138.6	147.1	156.6	164.2	172.7	181.2	189.8	14	2
14	3	148.7	150.7	153.8	157.5	160.2	162.5	164.7	166.8	169.1	171.8	175.6	178.7	180.7	139.2	147.7	156.2	164.7	173.2	181.7	190.2	14	3
14	4	149.3	151.3	154.3	158.1	160.8	163.0	165.2	167.3	169.6	172.3	176.1	179.1	181.1	139.8	148.2	156.7	165.2	173.7	182.1	190.6	14	4
14	5	149.8	151.8	154.9	158.6	161.3	163.6	165.7	167.8	170.1	172.8	176.5	179.6	181.6	140.4	148.8	157.3	165.7	174.1	182.6	191.0	14	5
14	6	150.4	152.4	155.4	159.1	161.8	164.1	166.2	168.3	170.6	173.3	177.0	180.0	182.0	141.0	149.4	157.8	166.2	174.6	183.0	191.4	14	6
14	7	151.0	152.9	156.0	159.7	162.3	164.6	166.7	168.8	171.1	173.7	177.4	180.4	182.4	141.6	150.0	158.3	166.7	175.0	183.4	191.7	14	7
14	8	151.6	153.5	156.5	160.2	162.8	165.1	167.2	169.3	171.5	174.1	177.8	180.8	182.8	142.3	150.6	158.9	167.2	175.5	183.8	192.1	14	8
14	9	152.1	154.1	157.1	160.7	163.3	165.5	167.6	169.7	172.0	174.6	178.2	181.2	183.1	142.9	151.1	159.4	167.6	175.9	184.1	192.4	14	9
14	10	152.7	154.6	157.6	161.2	163.8	166.0	168.1	170.2	172.4	175.0	178.6	181.6	183.5	143.5	151.7	159.9	168.1	176.3	184.5	192.7	14	10
14	11	153.3	155.2	158.1	161.7	164.3	166.5	168.6	170.6	172.8	175.4	179.0	181.9	183.8	144.2	152.3	160.4	168.6	176.7	184.8	192.9	14	11
15	0	153.8	155.7	158.7	162.2	164.8	167.0	169.0	171.0	173.2	175.8	179.3	182.3	184.2	144.8	152.9	160.9	169.0	177.1	185.1	193.2	15	0
15	1	154.4	156.3	159.2	162.7	165.2	167.4	169.4	171.5	173.6	176.2	179.7	182.6	184.5	145.5	153.5	161.4	169.4	177.4	185.4	193.4	15	1
15	2	155.0	156.8	159.7	163.2	165.7	167.9	169.9	171.9	174.0	176.5	180.0	182.9	184.8	146.1	154.0	161.9	169.9	177.8	185.7	193.6	15	2
15	3	155.5	157.4	160.2	163.7	166.2	168.3	170.3	172.3	174.4	176.9	180.3	183.2	185.1	146.7	154.6	162.4	170.3	178.1	186.0	193.8	15	3
15	4	156.1	157.9	160.7	164.1	166.6	168.7	170.7	172.7	174.8	177.2	180.7	183.5	185.3	147.3	155.1	162.9	170.7	178.5	186.2	194.0	15	4
15	5	156.6	158.4	161.2	164.6	167.0	169.1	171.1	173.0	175.1	177.6	181.0	183.8	185.6	148.0	155.7	163.4	171.1	178.8	186.5	194.2	15	5
15	6	157.1	158.9	161.7	165.0	167.5	169.5	171.5	173.4	175.5	177.9	181.3	184.0	185.8	148.6	156.2	163.8	171.5	179.1	186.7	194.4	15	6
15	7	157.6	159.4	162.2	165.5	167.9	169.9	171.8	173.8	175.8	178.2	181.5	184.3	186.1	149.2	156.7	164.3	171.8	179.4	187.0	194.5	15	7
15	8	158.1	159.9	162.6	165.9	168.3	170.3	172.2	174.1	176.1	178.5	181.8	184.5	186.3	149.8	157.2	164.7	172.2	179.7	187.2	194.7	15	8
15	9	158.6	160.4	163.1	166.3	168.7	170.7	172.6	174.4	176.4	178.8	182.1	184.8	186.5	150.3	157.7	165.2	172.6	180.0	187.4	194.8	15	9
15	10	159.1	160.8	163.5	166.7	169.1	171.0	172.9	174.8	176.8	179.1	182.3	185.0	186.7	150.9	158.2	165.6	172.9	180.2	187.6	194.9	15	10
15	11	159.6	161.3	163.9	167.1	169.4	171.4	173.2	175.1	177.0	179.3	182.5	185.2	186.9	151.4	158.7	166.0	173.2	180.5	187.8	195.0	15	11

TABLE 2—*Continued*

Age		Centiles													Standard deviations							Age	
Yrs	*Mths*	*3rd*	*5th*	*10th*	*20th*	*30th*	*40th*	*50th*	*60th*	*70th*	*80th*	*90th*	*95th*	*97th*	*−3S.D.*	*−2S.D.*	*−1S.D.*	*MEDIAN*	*+1S.D.*	*+2S.D.*	*+3S.D.*	*Yrs*	*Mths*
16	0	160.0	161.7	164.3	167.5	169.8	171.7	173.5	175.4	177.3	179.6	182.8	185.4	187.1	152.0	159.2	166.4	173.5	180.7	187.9	195.1	16	0
16	1	160.4	162.1	164.7	167.9	170.1	172.0	173.8	175.7	177.6	179.8	183.0	185.6	187.2	152.5	159.6	166.7	173.8	181.0	188.1	195.2	16	1
16	2	160.9	162.5	165.1	168.2	170.4	172.4	174.1	175.9	177.8	180.1	183.2	185.7	187.4	153.0	160.0	167.1	174.1	181.2	188.2	195.3	16	2
16	3	161.3	162.9	165.5	168.5	170.7	172.6	174.4	176.2	178.1	180.3	183.4	185.9	187.6	153.4	160.4	167.4	174.4	181.4	188.4	195.4	16	3
16	4	161.6	163.3	165.8	168.8	171.0	172.9	174.7	176.4	178.3	180.5	183.6	186.1	187.7	153.9	160.8	167.7	174.7	181.6	188.5	195.5	16	4
16	5	162.0	163.6	166.1	169.1	171.3	173.2	174.9	176.7	178.5	180.7	183.7	186.2	187.8	154.3	161.2	168.1	174.9	181.8	188.7	195.5	16	5
16	6	162.3	163.9	166.4	169.4	171.6	173.4	175.2	176.9	178.7	180.9	183.9	186.4	188.0	154.7	161.5	168.3	175.2	182.0	188.8	195.6	16	6
16	7	162.7	164.2	166.7	168.7	171.8	173.7	175.4	177.1	178.9	181.1	184.0	186.5	188.1	155.1	161.8	168.6	175.4	182.1	188.9	195.7	16	7
16	8	162.9	164.5	167.0	169.9	172.1	173.9	175.6	177.3	179.1	181.2	184.2	186.6	188.2	155.4	162.1	168.9	175.6	182.3	189.0	195.7	16	8
16	9	163.2	164.8	167.2	170.1	172.3	174.1	175.8	177.4	179.3	181.4	184.3	186.7	188.3	155.8	162.4	169.1	175.8	182.4	189.1	195.8	16	9
16	10	163.5	165.0	167.4	170.3	172.5	174.2	175.9	177.6	179.4	181.5	184.4	186.8	188.4	156.0	162.7	169.3	175.9	182.6	189.2	195.8	16	10
16	11	163.7	165.2	167.6	170.5	172.6	174.4	176.1	177.8	179.5	181.6	184.5	186.9	188.5	156.3	162.9	169.5	176.1	182.7	189.3	195.9	16	11
17	0	163.9	165.4	167.8	170.7	172.8	174.6	176.2	177.9	179.7	181.8	184.6	187.0	188.6	156.5	163.1	169.7	176.2	182.8	189.4	195.9	17	0
17	1	164.0	165.6	168.0	170.8	172.9	174.7	176.3	178.0	179.8	181.9	184.7	187.1	188.7	156.7	163.2	169.8	176.3	182.9	189.4	196.0	17	1
17	2	164.2	165.7	168.1	171.0	173.0	174.8	176.4	178.1	179.9	181.9	184.8	187.2	188.7	156.9	163.4	169.9	176.4	183.0	189.5	196.0	17	2
17	3	164.3	165.8	168.2	171.1	173.1	174.9	176.5	178.2	180.0	182.0	184.9	187.3	188.8	157.0	163.5	170.0	176.5	183.1	189.6	196.1	17	3
17	4	164.4	165.9	168.3	171.1	173.2	175.0	176.6	178.3	180.0	182.1	185.0	187.3	188.9	157.1	163.6	170.1	176.6	183.1	189.6	196.2	17	4
17	5	164.4	166.0	168.3	171.2	173.3	175.0	176.7	178.3	180.1	182.2	185.0	187.4	188.9	157.1	163.7	170.2	176.7	183.2	189.7	196.2	17	5
17	6	164.5	166.0	168.4	171.2	173.3	175.1	176.7	178.4	180.1	182.2	185.1	187.5	189.0	157.2	163.7	170.2	176.7	183.2	189.8	196.3	17	6
17	7	164.5	166.0	168.4	171.3	173.3	175.1	176.8	178.4	180.2	182.3	185.1	187.5	189.0	157.2	163.7	170.2	176.8	183.3	189.8	196.3	17	7
17	8	164.5	166.1	168.4	171.3	173.4	175.1	176.8	178.5	180.2	182.3	185.2	187.5	189.1	157.2	163.7	170.3	176.8	183.3	189.9	196.4	17	8
17	9	164.5	166.1	168.4	171.3	173.4	175.2	176.8	178.5	180.2	182.3	185.2	187.6	189.1	157.2	163.7	170.3	176.8	183.4	189.9	196.5	17	9
17	10	164.5	166.0	168.4	171.3	173.4	175.2	176.8	178.5	180.3	182.3	185.2	187.6	189.2	157.1	163.7	170.3	176.8	183.4	189.9	196.5	17	10
17	11	164.5	166.0	168.4	171.3	173.4	175.2	176.8	178.5	180.3	182.4	185.3	187.6	189.2	157.1	163.7	170.2	176.8	183.4	190.0	196.6	17	11
18	0	164.4	166.0	168.4	171.3	173.4	175.2	176.8	178.5	180.3	182.4	185.3	187.7	189.2	157.0	163.6	170.2	176.8	183.4	190.0	196.6	18	0

TABLE 3

Length (cm) by Age of Girls aged 0–36 months

Age Months	Centiles												Standard deviations							Age Months
	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	
0	45.8	46.3	47.1	48.0	48.7	49.3	49.9	50.4	51.0	51.7	52.6	53.4	53.9	43.4	45.5	47.7	49.9	52.0	54.2	56.4	
1	49.2	49.8	50.6	51.6	52.3	53.0	53.5	54.1	54.8	55.5	56.5	57.3	57.9	46.7	49.0	51.2	53.5	55.8	58.1	60.4	1
2	52.2	52.8	53.7	54.7	55.5	56.1	56.8	57.4	58.0	58.8	59.8	60.7	61.3	49.6	52.0	54.4	56.8	59.2	61.6	64.0	2
3	54.9	55.5	56.4	57.5	58.2	58.9	59.5	60.2	60.9	61.6	62.7	63.6	64.2	52.1	54.6	57.8	59.5	62.0	64.5	67.0	3
4	57.2	57.8	58.7	59.8	60.6	61.3	62.0	62.6	63.3	64.1	65.2	66.2	66.8	54.3	56.9	59.4	62.0	64.5	67.1	69.6	4
5	59.2	59.8	60.7	61.9	62.7	63.4	64.1	64.7	65.4	66.3	67.4	68.4	69.0	56.3	58.9	61.5	64.1	66.7	69.3	71.9	5
6	61.0	61.6	62.5	63.7	64.5	65.3	65.9	66.6	67.3	68.2	69.3	70.3	70.9	58.0	60.6	63.3	65.9	68.6	71.2	73.9	6
7	62.5	63.2	64.1	65.3	66.2	66.9	67.6	68.3	69.0	69.8	71.0	72.0	72.6	59.5	62.2	64.9	67.6	70.2	72.9	75.6	7
8	64.0	64.6	65.6	66.8	67.6	68.4	69.1	69.7	70.5	71.3	72.5	73.5	74.2	60.9	63.7	66.4	69.1	71.8	74.5	77.2	8
9	65.3	66.0	66.9	68.1	69.0	69.8	70.4	71.1	71.9	72.8	74.0	74.9	75.6	62.2	65.0	67.7	70.4	73.2	75.9	78.7	9
10	66.6	67.2	68.2	69.5	70.3	71.1	71.8	72.5	73.2	74.1	75.3	76.3	77.0	63.5	66.2	69.0	71.8	74.5	77.3	80.1	10
11	67.8	68.5	69.5	70.7	71.6	72.4	73.1	73.8	74.5	75.4	76.6	77.7	78.3	64.7	67.5	70.3	73.1	75.9	78.7	81.5	11
12	69.0	69.6	70.7	71.9	72.8	73.6	74.3	75.0	75.8	76.7	77.9	79.0	79.6	65.8	68.6	71.5	74.3	77.1	80.0	82.8	12
13	70.1	70.8	71.8	73.1	74.0	74.8	75.5	76.2	77.0	77.9	79.2	80.2	80.9	66.9	69.8	72.6	75.5	78.4	81.2	84.1	13
14	71.2	71.9	72.9	74.2	75.1	75.9	76.7	77.4	78.2	79.1	80.4	81.4	82.1	67.9	70.8	73.7	76.7	79.6	82.5	85.4	14
15	72.2	72.9	74.0	75.3	76.2	77.0	77.8	78.5	79.3	80.3	81.6	82.6	83.3	68.9	71.9	74.8	77.8	80.7	83.7	86.6	15
16	73.2	73.9	75.0	76.3	77.3	78.1	78.9	79.6	80.4	81.4	82.7	83.8	84.5	69.9	72.9	75.9	78.9	81.8	84.8	87.8	16
17	74.2	74.9	76.0	77.4	78.3	79.1	79.9	80.7	81.5	82.5	83.8	84.9	85.6	70.8	73.8	76.9	79.9	82.9	86.0	89.0	17
18	75.1	75.9	77.0	78.3	79.3	80.1	80.9	81.7	82.5	83.5	84.9	86.0	86.7	71.7	74.8	77.9	80.9	84.0	87.1	90.1	18

TABLE 3—*Continued*

Age Months	Centiles													Standard deviations							Age Months
	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	
19	76.1	76.8	77.9	79.3	80.3	81.1	81.9	82.7	83.5	84.5	85.9	87.0	87.8	72.6	75.7	78.8	81.9	85.0	88.1	91.2	19
20	77.0	77.7	78.8	80.2	81.2	82.1	82.9	83.7	84.5	85.5	86.9	88.0	88.8	73.4	76.6	79.7	82.9	86.0	89.2	92.3	20
21	77.8	78.6	79.7	81.1	82.1	83.0	83.8	84.6	85.5	86.5	87.9	89.0	89.8	74.3	77.4	80.6	83.8	87.0	90.2	93.4	21
22	78.7	79.4	80.6	82.0	83.0	83.9	84.7	85.5	86.4	87.4	88.8	90.0	90.8	75.1	78.3	81.5	84.7	87.9	91.1	94.4	22
23	79.5	80.3	81.4	82.9	83.9	84.8	85.6	86.4	87.3	88.3	89.8	90.9	91.7	75.9	79.1	82.4	85.6	88.9	92.1	95.3	23
24	80.3	81.1	82.3	83.7	84.8	85.6	86.5	87.3	88.2	89.2	90.7	91.9	92.6	76.6	79.9	83.2	86.5	89.8	93.0	96.3	24
25	81.1	81.9	83.1	84.5	85.6	86.5	87.3	88.2	89.1	90.1	91.6	92.8	93.5	77.4	80.7	84.0	87.3	90.6	93.9	97.2	25
26	81.9	82.7	83.9	85.4	86.4	87.3	88.2	89.0	89.9	91.0	92.4	93.6	94.4	78.2	81.5	84.8	88.2	91.5	94.8	98.1	26
27	82.7	83.5	84.7	86.2	87.2	88.1	89.0	89.8	90.7	91.8	93.3	94.5	95.3	78.9	82.3	85.6	89.0	92.3	95.7	99.0	27
28	83.4	84.2	85.5	86.9	88.0	88.9	89.8	90.6	91.5	92.6	94.1	95.3	96.1	79.7	83.0	86.4	89.8	93.1	96.5	99.9	28
29	84.2	85.0	86.2	87.7	88.8	89.7	90.6	91.4	92.3	93.4	94.9	96.1	96.9	80.4	83.8	87.2	90.6	93.9	97.3	100.7	29
30	84.9	85.7	86.9	88.4	89.5	90.5	91.3	92.2	93.1	94.2	95.7	96.9	97.7	81.1	84.5	87.9	91.3	94.7	98.1	101.5	30
31	85.6	86.4	87.7	89.2	90.3	91.2	92.1	92.9	93.9	95.0	96.5	97.7	98.5	81.8	85.2	88.6	92.1	95.5	98.9	102.4	31
32	86.3	87.1	88.4	89.9	91.0	91.9	92.8	93.7	94.6	95.7	97.2	98.5	99.3	82.4	85.9	89.3	92.8	96.3	99.7	103.2	32
33	87.0	87.8	89.1	90.6	91.7	92.6	93.5	94.4	95.3	96.4	98.0	99.2	100.1	83.1	86.6	90.0	93.5	97.0	100.5	104.0	33
34	87.6	88.4	89.7	91.3	92.4	93.3	94.2	95.1	96.1	97.2	98.7	100.0	100.8	83.7	87.2	90.7	94.2	97.7	101.2	104.7	34
35	88.2	89.1	90.4	91.9	93.0	94.0	94.9	95.8	96.8	97.9	99.4	100.7	101.6	84.3	87.8	91.4	94.9	98.4	102.0	105.5	35
36	88.8	89.7	91.0	92.6	93.7	94.7	95.6	96.5	97.4	98.6	100.2	101.5	102.3	84.8	88.4	92.0	95.6	99.1	102.7	106.3	36

TABLE 4

Stature (cm) by Age of Girls aged 2–18 years

Age		Centiles												Standard deviations							Age	
Yrs	Mths	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	Yrs	Mths
2	0	78.5	79.2	80.4	81.8	82.8	83.7	84.5	85.3	86.2	87.2	88.6	89.8	90.5	74.9	78.1	81.3	84.5	87.7	90.9	94.1	2	0
2	1	79.2	80.0	81.2	82.6	83.6	84.5	85.4	86.2	87.1	88.1	89.5	90.7	91.5	75.6	78.8	82.1	85.4	88.6	91.9	95.1	2	1
2	2	80.0	80.8	82.0	83.4	84.5	85.4	86.2	87.0	87.9	89.0	90.5	91.7	92.4	76.3	79.6	82.9	86.2	89.5	92.8	96.2	2	2
2	3	80.7	81.5	82.7	84.2	85.3	86.2	87.0	87.9	88.8	89.9	91.4	92.6	93.4	77.0	80.3	83.7	87.0	90.4	93.8	97.1	2	3
2	4	81.4	82.3	83.5	85.0	86.1	87.0	87.9	88.7	89.7	90.7	92.2	93.5	94.3	77.6	81.0	84.5	87.9	91.3	94.7	98.1	2	4
2	5	82.2	83.0	84.2	85.8	86.9	87.8	88.7	89.5	90.5	91.6	93.1	94.4	95.2	78.3	81.8	85.2	88.7	92.1	95.6	99.0	2	5
2	6	82.9	83.7	85.0	86.5	87.6	88.6	89.5	90.3	91.3	92.4	93.9	95.2	96.0	79.0	82.5	86.0	89.5	93.0	96.5	100.0	2	6
2	7	83.6	84.4	85.7	87.3	88.4	89.3	90.2	91.1	92.1	93.2	94.8	96.1	96.9	79.6	83.2	86.7	90.2	93.8	97.3	100.9	2	7
2	8	84.3	85.1	86.4	88.0	89.1	90.1	91.0	91.9	92.9	94.0	95.6	96.9	97.7	80.3	83.8	87.4	91.0	94.6	98.2	101.7	2	8
2	9	84.9	85.8	87.1	88.7	89.8	90.8	91.7	92.7	93.6	94.8	96.4	97.7	98.6	80.9	84.5	88.1	91.7	95.4	99.0	102.6	2	9
2	10	85.6	86.5	87.8	89.4	90.6	91.6	92.5	93.4	94.4	95.6	97.2	98.5	99.4	81.5	85.2	88.8	92.5	96.1	99.8	103.4	2	10
2	11	86.3	87.1	88.5	90.1	91.3	92.3	93.2	94.1	95.1	96.3	97.9	99.3	100.1	82.1	85.8	89.5	93.2	96.9	100.6	104.3	2	11
3	0	86.9	87.8	89.1	90.8	92.0	93.0	93.9	94.9	95.9	97.0	98.7	100.0	100.9	82.8	86.5	90.2	93.9	97.6	101.4	105.1	3	0
3	1	87.6	88.4	89.8	91.5	92.6	93.7	94.6	95.6	96.6	97.8	99.4	100.8	101.7	83.4	87.1	90.9	94.6	98.4	102.1	105.9	3	1
3	2	88.2	89.1	90.4	92.1	93.3	94.3	95.3	96.3	97.3	98.5	100.1	101.5	102.4	84.0	87.7	91.5	95.3	99.1	102.9	106.6	3	3
3	3	88.8	89.7	91.1	92.8	94.0	95.0	96.0	96.9	98.0	99.2	100.9	102.2	103.1	84.5	88.4	92.2	96.0	99.8	103.6	107.4	3	3
3	4	89.4	90.3	91.7	93.4	94.6	95.7	96.6	97.6	98.6	99.9	101.6	103.0	103.9	85.1	89.0	92.8	96.6	100.5	104.3	108.2	3	4
3	5	90.0	90.9	92.3	94.0	95.3	96.3	97.3	98.3	99.3	100.5	102.2	103.6	104.6	85.7	89.6	93.4	97.3	101.2	105.0	108.9	3	5
3	6	90.6	91.5	92.9	94.7	95.9	97.0	97.9	98.9	100.0	101.2	102.9	104.3	105.3	86.3	90.2	94.0	97.9	101.8	105.7	109.6	3	6
3	7	91.2	92.1	93.5	95.3	96.5	97.6	98.6	99.6	100.6	101.9	103.6	105.0	105.9	86.8	90.7	94.7	98.6	102.5	106.4	110.3	3	7
3	8	91.8	92.7	94.1	95.9	97.1	98.2	99.2	100.2	101.3	102.5	104.3	105.7	106.6	87.4	91.3	95.3	99.2	103.1	107.1	111.0	3	8
3	9	92.3	93.3	94.7	96.5	97.7	98.8	99.8	100.8	101.9	103.2	104.9	106.3	107.3	87.9	91.9	95.8	99.8	103.8	107.8	111.7	3	9
3	10	92.9	93.9	95.3	97.1	98.3	99.4	100.4	101.4	102.5	103.8	105.6	107.0	107.9	88.4	92.4	96.4	100.4	104.4	108.4	112.4	3	10
3	11	93.5	94.4	95.9	97.6	98.9	100.0	101.0	102.1	103.1	104.4	106.2	107.6	108.6	89.0	93.0	97.0	101.0	105.1	109.1	113.1	3	11

TABLE 4—*Continued*

Age		Centiles													Standard deviations							Age	
Yrs	Mths	3rd	5th	10th	20th	30th	40hh	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	Yrs	Mths
4	0	94.0	95.0	96.4	98.2	99.5	100.6	101.6	102.7	103.8	105.0	106.8	108.3	109.2	89.5	93.5	97.6	101.6	105.7	109.7	113.8	4	0
4	1	94.6	95.5	97.0	98.8	100.1	101.2	102.2	103.3	104.4	105.6	107.4	108.9	109.9	90.0	94.1	98.1	102.2	106.3	110.4	114.4	4	1
4	2	95.1	96.1	97.5	99.3	100.7	101.8	102.8	103.8	105.0	106.3	108.1	109.5	110.5	90.5	94.6	98.7	102.8	106.9	111.0	115.1	4	2
4	3	95.6	96.6	98.1	99.9	101.2	102.3	103.4	104.4	105.5	106.9	108.7	110.2	111.1	91.0	95.1	99.3	103.4	107.5	111.6	115.8	4	3
4	4	96.1	97.1	98.6	100.5	101.8	102.9	104.0	105.0	106.1	107.5	109.3	110.8	111.8	91.5	95.6	99.8	104.0	108.1	112.3	116.4	4	4
4	5	96.6	97.6	99.2	101.0	102.3	103.5	104.5	105.6	106.7	108.0	109.9	111.4	112.4	92.0	96.1	100.3	104.5	108.7	112.9	117.1	4	5
4	6	97.2	98.1	99.7	101.5	102.9	104.0	105.1	106.2	107.3	108.6	110.5	112.0	113.0	92.4	96.7	100.9	105.1	109.3	113.5	117.7	4	6
4	7	97.7	98.7	100.2	102.1	103.4	104.6	105.6	106.7	107.9	109.2	111.1	112.6	113.6	92.9	97.1	101.4	105.6	109.9	114.1	118.4	4	7
4	8	98.1	99.2	100.7	102.6	104.0	105.1	106.2	107.3	108.4	109.8	111.7	113.2	114.2	93.4	97.6	101.9	106.2	110.5	114.8	119.0	4	8
4	9	98.6	99.7	101.2	103.1	104.5	105.7	106.7	107.8	109.0	110.4	112.3	113.8	114.9	93.8	98.1	102.4	106.7	111.1	115.4	119.7	4	9
4	10	99.1	100.1	101.7	103.6	105.0	106.2	107.3	108.4	109.6	111.0	112.9	114.4	115.5	94.3	98.6	102.9	107.3	111.6	116.0	120.3	4	10
4	11	99.6	100.6	102.2	104.2	105.5	106.7	107.8	109.0	110.1	111.5	113.5	115.1	116.1	94.7	99.1	103.5	107.8	112.2	116.6	121.0	4	11
5	0	100.1	101.1	102.7	104.7	106.1	107.3	108.4	109.5	110.7	112.1	114.0	115.7	116.7	95.1	99.5	104.0	108.4	112.8	117.2	121.6	5	0
5	1	100.5	101.6	103.2	105.2	106.6	107.8	108.9	110.0	111.3	112.7	114.6	116.3	117.3	95.5	100.0	104.5	108.9	113.4	117.8	122.3	5	1
5	2	101.0	102.1	103.7	105.7	107.1	108.3	109.5	110.6	111.8	113.2	115.2	116.8	117.9	96.0	100.5	105.0	109.5	113.9	118.4	122.9	5	2
5	3	101.5	102.5	104.2	106.2	107.6	108.8	110.0	111.1	112.4	113.8	115.8	117.4	118.5	96.4	100.9	105.4	110.0	114.5	119.1	123.6	5	3
5	4	101.9	103.0	104.6	106.7	108.1	109.4	110.5	111.7	112.9	114.4	116.4	118.0	119.1	96.8	101.4	105.9	110.5	115.1	119.7	124.2	5	4
5	5	102.4	103.4	105.1	107.1	108.6	109.9	111.0	112.2	113.5	114.9	117.0	118.6	119.7	97.2	101.8	106.4	111.0	115.7	120.3	124.9	5	5
5	6	102.8	103.9	105.6	107.6	109.1	110.4	111.6	112.7	114.0	115.5	117.5	119.2	120.3	97.6	102.2	106.9	111.6	116.2	120.9	125.5	5	6
5	7	103.2	104.3	106.1	108.1	109.6	110.9	112.1	113.3	114.5	116.0	118.1	119.8	120.9	98.0	102.7	107.4	112.1	116.8	121.5	126.2	5	7
5	8	103.7	104.8	106.5	108.6	110.1	111.4	112.6	113.8	115.1	116.6	118.7	120.4	121.5	98.4	103.1	107.9	112.6	117.3	122.1	126.8	5	8
5	9	104.1	105.2	107.0	109.1	110.6	111.9	113.1	114.3	115.6	117.1	119.2	121.0	122.1	98.8	103.5	108.3	113.1	117.9	122.7	127.5	5	9
5	10	104.5	105.7	107.4	109.6	111.1	112.4	113.6	114.8	116.1	117.7	119.8	121.6	122.7	99.1	104.0	108.8	113.6	118.4	123.3	128.1	5	10
5	11	105.0	106.1	107.9	110.0	111.6	112.9	114.1	115.4	116.7	118.2	120.4	122.1	123.3	99.5	104.4	109.3	114.1	119.0	123.9	128.7	5	11

TABLE 4—*Continued*

Age		Centiles												Standard deviations							Age	
Yrs	Mths	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	Yrs	Mths
6	0	105.4	106.5	108.3	110.5	112.1	113.4	114.6	115.9	117.2	118.8	120.9	122.7	123.9	99.9	104.8	109.7	114.6	119.6	124.5	129.4	6	0
6	1	105.8	107.0	108.8	111.0	112.5	113.9	115.1	116.4	117.7	119.3	121.5	123.3	124.5	100.2	105.2	110.2	115.1	120.1	125.1	130.0	6	1
6	2	106.2	107.4	109.2	111.4	113.0	114.4	115.6	116.9	118.3	119.9	122.1	123.9	125.1	100.6	105.6	110.6	115.6	120.6	125.7	130.7	6	2
6	3	106.6	107.8	109.7	111.9	113.5	114.9	116.1	117.4	118.8	120.4	122.6	124.5	125.7	101.0	106.0	111.1	116.1	121.2	126.3	131.3	6	3
6	4	107.0	108.2	110.1	112.3	114.0	115.3	116.6	117.9	119.3	120.9	123.2	125.0	126.2	101.3	106.4	111.5	116.6	121.7	126.8	131.9	6	4
6	5	107.4	108.7	110.5	112.8	114.4	115.8	117.1	118.4	119.8	121.5	123.7	125.6	126.8	101.7	106.8	112.0	117.1	122.3	127.4	132.6	6	5
6	6	107.9	109.1	111.0	113.3	114.9	116.3	117.6	118.9	120.4	122.0	124.3	126.2	127.4	102.0	107.2	112.4	117.6	122.8	128.0	133.2	6	6
6	7	108.3	109.5	111.4	113.7	115.4	116.8	118.1	119.5	120.9	122.5	124.8	126.7	128.0	102.4	107.6	112.9	118.1	123.4	128.6	133.9	6	7
6	8	108.7	109.9	111.8	114.2	115.8	117.3	118.6	120.0	121.4	123.1	125.4	127.3	128.6	102.7	108.0	113.3	118.6	123.9	129.2	134.5	6	8
6	9	109.1	110.3	112.3	114.6	116.3	117.8	119.1	120.5	121.9	123.6	125.9	127.9	129.1	103.1	108.4	113.8	119.1	124.4	129.8	135.1	6	9
6	10	109.5	110.7	112.7	115.1	116.8	118.2	119.6	121.0	122.4	124.1	126.5	128.5	129.7	103.4	108.8	114.2	119.6	125.0	130.4	135.8	6	10
6	11	109.9	111.2	113.1	115.5	117.2	118.7	120.1	121.5	122.9	124.7	127.0	129.0	130.3	103.8	109.2	114.7	120.1	125.5	131.0	136.4	6	11
7	0	110.3	111.6	113.6	116.0	117.7	119.2	120.6	122.0	123.4	125.2	127.6	129.6	130.9	104.1	119.6	115.1	120.6	126.1	131.5	137.0	7	0
7	1	110.7	112.0	114.0	116.4	118.2	119.7	121.1	122.5	124.0	125.7	128.1	130.2	131.5	104.5	110.0	115.5	121.1	126.6	132.1	137.6	7	1
7	2	111.1	112.4	114.4	116.9	118.6	120.1	121.5	123.0	124.5	126.2	128.7	130.7	132.0	104.8	110.4	116.0	121.5	127.1	132.7	138.3	7	2
7	3	111.5	112.8	114.8	117.3	119.1	120.6	122.0	123.5	125.0	126.8	129.2	131.3	132.6	105.2	110.8	116.4	122.0	127.7	133.3	138.9	7	3
7	4	111.9	113.2	115.3	117.7	119.5	121.1	122.5	124.0	125.5	127.3	129.8	131.8	133.2	105.5	111.2	116.8	122.5	128.2	133.9	139.5	7	4
7	5	112.2	113.6	115.7	118.2	120.0	121.6	123.0	124.4	126.0	127.8	130.3	132.4	133.8	105.9	111.6	117.3	123.0	128.7	134.4	140.1	7	5
7	6	112.6	114.0	116.1	118.6	120.5	122.0	123.5	124.9	126.5	128.3	130.9	133.0	134.3	106.2	112.0	117.7	123.5	129.2	135.0	140.8	7	6
7	7	113.0	114.4	116.5	119.1	120.9	122.5	124.0	125.4	127.0	128.9	131.4	133.5	134.9	106.5	112.4	118.2	124.0	129.8	135.6	141.4	7	7
7	8	113.4	114.8	116.9	119.5	121.4	123.0	124.5	125.9	127.5	129.4	132.0	134.1	135.5	106.9	112.7	118.6	124.5	130.3	136.2	142.0	7	8
7	9	113.8	115.2	117.4	120.0	121.8	123.4	124.9	126.4	128.0	129.9	132.5	134.6	136.0	107.2	113.1	119.0	124.9	130.8	136.7	142.6	7	9
7	10	114.2	115.6	117.8	120.4	122.3	123.9	125.4	126.9	128.5	130.4	133.0	135.2	136.6	107.6	113.5	119.5	125.4	131.4	137.3	143.2	7	10
7	11	114.6	116.0	118.2	120.9	122.8	124.4	125.9	127.4	129.0	130.9	133.6	135.8	137.2	107.9	113.9	119.9	125.9	131.9	137.9	143.9	7	11

TABLE 4—*Continued*

Age		Centiles												Standard deviations							Age	
Yrs	*Mths*	*3rd*	*5th*	*10th*	*20th*	*30th*	*40th*	*50th*	*60th*	*70th*	*80th*	*90th*	*95th*	*97th*	*−3S.D.*	*−2S.D.*	*−1S.D.*	*MEDIAN*	*+1S.D.*	*+2S.D.*	*+3S.D.*	*Yrs*	*Mths*
8	0	115.0	116.5	118.7	121.3	123.2	124.9	126.4	127.9	129.5	131.5	134.1	136.3	137.7	108.3	114.3	120.4	126.4	132.4	138.4	144.5	8	0
8	1	115.4	116.9	119.1	121.8	123.7	125.3	126.9	128.4	130.1	132.0	134.7	136.9	138.3	108.6	114.7	120.8	126.9	132.9	139.0	145.1	8	1
8	2	115.8	117.3	119.5	122.2	124.1	125.8	127.4	128.9	130.6	132.5	135.2	137.4	138.9	109.0	115.1	121.2	127.4	133.5	139.6	145.7	8	2
8	3	116.2	117.7	119.9	122.6	124.6	126.3	127.8	129.4	131.1	133.0	135.7	138.0	139.4	109.4	115.5	121.7	127.8	134.0	140.2	146.3	8	3
8	4	116.7	118.1	120.4	123.1	125.1	126.7	128.3	129.9	131.6	133.5	136.3	138.5	140.0	109.7	115.9	122.1	128.3	134.5	140.7	146.9	8	4
8	5	117.1	118.5	120.8	123.6	125.5	127.2	128.8	130.4	132.1	134.1	136.8	139.1	140.6	110.1	116.3	122.6	128.8	135.0	141.3	147.5	8	5
8	6	117.5	119.0	121.2	124.0	126.0	127.7	129.3	130.9	132.6	134.6	137.3	139.6	141.1	110.4	116.7	123.0	129.3	135.6	141.9	148.1	8	6
8	7	117.9	119.4	121.7	124.5	126.5	128.2	129.8	131.4	133.1	135.1	137.9	140.2	141.7	110.8	117.1	123.5	129.8	136.1	142.4	148.8	8	7
8	8	118.3	119.8	122.1	124.9	126.9	128.7	130.3	131.9	133.6	135.6	138.4	140.7	142.2	111.2	117.5	123.9	130.3	136.6	143.0	149.4	8	8
8	9	118.7	120.2	122.6	125.4	127.4	129.1	130.8	132.4	134.1	136.1	139.0	141.3	142.8	111.6	118.0	124.4	130.8	137.2	143.6	150.0	8	9
8	10	119.1	120.7	123.0	125.8	127.9	129.6	131.2	132.9	134.6	136.7	139.5	141.8	143.4	111.9	118.4	124.8	131.2	137.7	144.1	150.6	8	10
8	11	119.6	121.1	123.4	126.3	128.3	130.1	131.7	133.4	135.1	137.2	140.0	142.4	143.9	112.3	118.8	125.3	131.7	138.2	144.7	151.2	8	11
9	0	120.0	121.5	123.9	126.8	128.8	130.6	132.2	133.9	135.6	137.7	140.6	142.9	144.5	112.7	119.2	125.7	132.2	138.7	145.3	151.8	9	0
9	1	120.4	122.0	124.3	127.2	129.3	131.1	132.7	134.4	136.2	138.2	141.1	143.5	145.0	113.1	119.6	126.2	132.7	139.3	145.8	152.4	9	1
9	2	120.9	122.4	124.8	127.7	129.8	131.6	133.2	134.9	136.7	138.8	141.7	144.0	145.6	113.5	120.1	126.7	133.2	139.8	146.4	153.0	9	2
9	3	121.3	122.9	125.3	128.2	130.3	132.1	133.7	135.4	137.2	139.3	142.2	144.6	146.2	113.9	120.5	127.1	133.7	140.3	146.9	153.5	9	3
9	4	121.7	123.3	125.7	128.6	130.7	132.5	134.2	135.9	137.7	139.8	142.7	145.1	146.7	114.3	121.0	127.6	134.2	140.9	147.5	154.1	9	4
9	5	122.2	123.8	126.2	129.1	131.2	133.0	134.7	136.4	138.2	140.3	143.3	145.7	147.3	114.7	121.4	128.1	134.7	141.4	148.1	154.7	9	5
9	6	122.6	124.2	126.7	129.6	131.7	133.5	135.2	136.9	138.7	140.9	143.8	146.2	147.8	115.2	121.8	128.5	135.2	141.9	148.6	155.3	9	6
9	7	123.1	124.7	127.1	130.1	132.2	134.0	135.7	137.4	139.3	141.4	144.4	146.8	148.4	115.6	122.3	129.0	135.7	142.5	149.2	155.9	9	7
9	8	123.6	125.2	127.6	130.6	132.7	134.5	136.2	138.0	139.8	141.9	144.9	147.3	148.9	116.0	122.8	129.5	136.2	143.0	149.7	156.5	9	8
9	9	124.0	125.6	128.1	131.1	133.2	135.0	136.8	138.5	140.3	142.5	145.4	147.9	149.5	116.4	123.2	130.0	136.8	143.5	150.3	157.1	9	9
9	10	124.5	126.1	128.6	131.6	133.7	135.6	137.3	139.0	140.8	143.0	146.0	148.5	150.1	116.9	123.7	130.5	137.3	144.1	150.9	157.7	9	10
9	11	125.0	126.6	129.1	132.1	134.2	136.1	137.8	139.5	141.4	143.5	146.5	149.0	150.6	117.3	124.2	131.0	137.8	144.6	151.4	158.2	9	11

TABLE 4—*Continued*

Age		Centiles												Standard deviations							Age	
Yrs	Months	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	Yrs	Mths
10	0	125.4	127.1	129.5	132.6	134.7	136.6	138.3	140.0	141.9	144.1	147.1	149.6	151.2	117.8	124.6	131.5	138.3	145.1	152.0	158.8	10	0
10	1	125.9	127.6	130.0	133.1	135.2	137.1	138.8	140.6	142.4	144.6	147.6	150.1	151.7	118.3	125.1	132.0	138.8	145.7	152.5	159.4	10	1
10	2	126.4	128.1	130.6	133.6	135.8	137.6	139.4	141.1	143.0	145.1	148.2	150.7	152.3	118.7	125.6	132.5	139.4	146.2	153.1	160.0	10	2
10	3	126.9	128.6	131.1	134.1	136.3	138.1	139.9	141.6	143.5	145.7	148.7	151.2	152.8	119.2	126.1	133.0	139.9	146.8	153.7	160.5	10	3
10	4	127.4	129.1	131.6	134.6	136.8	138.7	140.4	142.2	144.0	146.2	149.3	151.8	153.4	119.7	126.6	133.5	140.4	147.3	154.2	161.1	10	4
10	5	127.9	129.6	132.1	135.1	137.3	139.2	140.9	142.7	144.6	146.8	149.8	152.3	154.0	120.2	127.1	134.0	140.9	147.9	154.8	161.7	10	5
10	6	128.5	130.1	132.6	135.7	137.9	139.7	141.5	143.2	145.1	147.3	150.4	152.9	154.5	120.7	127.6	134.6	141.5	148.4	155.3	162.3	10	6
10	7	129.0	130.6	133.1	136.2	138.4	140.3	142.0	143.8	145.7	147.9	150.9	153.4	155.1	121.2	128.2	135.1	142.0	149.0	155.9	162.8	10	7
10	8	129.5	131.2	133.7	136.7	138.9	140.8	142.6	144.3	146.2	148.4	151.5	154.0	155.6	121.8	128.7	135.6	142.6	149.5	156.4	163.4	10	8
10	9	130.1	131.7	134.2	137.3	139.5	141.4	143.1	144.9	146.8	149.0	152.0	154.5	156.2	122.3	129.2	136.2	143.1	150.1	157.0	163.9	10	9
10	10	130.6	132.2	134.8	137.8	140.0	141.9	143.7	145.4	147.3	149.5	152.6	155.1	156.7	122.8	129.8	136.7	143.7	150.6	157.6	164.5	10	10
10	11	131.2	132.8	135.3	138.4	140.6	142.5	144.2	146.0	147.9	150.1	153.1	155.6	157.3	123.4	130.3	137.3	144.2	151.2	158.1	165.1	10	11
11	0	131.7	133.4	135.9	138.9	141.1	143.0	144.8	146.5	148.4	150.6	153.7	156.2	157.8	123.9	130.9	137.8	144.8	151.7	158.7	165.6	11	0
11	1	132.3	133.9	136.4	139.5	141.7	143.6	145.3	147.1	149.0	151.2	154.2	156.8	158.4	124.5	131.5	138.4	145.3	152.3	159.2	166.2	11	1
11	2	132.9	134.5	137.0	140.1	142.3	144.2	145.9	147.7	149.5	151.8	154.8	157.3	159.0	125.1	132.0	139.0	145.9	152.8	159.8	166.7	11	2
11	3	133.4	135.1	137.6	140.6	142.8	144.7	146.5	148.2	150.1	152.3	155.4	157.9	159.5	125.7	132.6	139.5	146.5	153.4	160.3	167.3	11	3
11	4	134.0	135.7	138.2	141.2	143.4	145.3	147.0	148.8	150.7	152.9	155.9	158.4	160.1	126.3	133.2	140.1	147.0	154.0	160.9	167.8	11	4
11	5	134.6	136.2	138.8	141.8	144.0	145.9	147.6	149.4	151.2	153.4	156.5	159.0	160.6	126.9	133.8	140.7	147.6	154.5	161.4	168.4	11	5
11	6	135.2	136.8	139.3	142.4	144.6	146.4	148.2	149.9	151.8	154.0	157.0	159.5	161.2	127.5	134.4	141.3	148.2	155.1	162.0	168.9	11	6
11	7	135.8	137.4	139.9	142.9	145.1	147.0	148.8	150.5	152.4	154.6	157.6	160.1	161.7	128.1	135.0	141.9	148.8	155.6	162.5	169.4	11	7
11	8	136.4	138.0	140.5	143.5	145.7	147.6	149.3	151.1	152.9	155.1	158.1	160.6	162.3	128.7	135.6	142.4	149.3	156.2	163.1	170.0	11	8
11	9	137.0	138.6	141.1	144.1	146.3	148.1	149.9	151.6	153.5	155.7	158.7	161.2	162.8	129.3	136.1	143.0	149.9	156.7	163.6	170.5	11	9
11	10	137.5	139.2	141.6	144.7	146.8	148.7	150.4	152.2	154.0	156.2	159.2	161.7	163.3	129.9	136.7	143.6	150.4	157.3	164.1	171.0	11	10
11	11	138.1	139.7	142.2	145.2	147.4	149.2	151.0	152.7	154.6	156.7	159.7	162.2	163.8	130.5	137.3	144.1	151.0	157.8	164.7	171.5	11	11

TABLE 4—*Continued*

Age		Centiles												Standard deviations							Age	
Yrs	Mths	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	Yrs	Mths
12	0	138.7	140.3	142.8	145.8	147.9	149.8	151.5	153.2	155.1	157.3	160.3	162.7	164.4	131.1	137.9	144.7	151.5	158.3	165.2	172.0	12	0
12	1	139.2	140.9	143.3	146.3	148.5	150.3	152.1	153.8	155.6	157.8	160.8	163.3	164.9	131.6	138.4	145.2	152.1	158.9	165.7	172.5	12	1
12	2	139.8	141.4	143.9	146.9	149.0	150.9	152.6	154.3	156.1	158.3	161.3	163.8	165.4	132.2	139.0	145.8	152.6	159.4	166.2	173.0	12	2
12	3	140.3	141.9	144.4	147.4	149.5	151.4	153.1	154.8	156.6	158.8	161.8	164.2	165.8	132.8	139.5	146.3	153.1	159.9	166.6	173.4	12	3
12	4	140.9	142.5	144.9	147.9	150.1	151.9	153.6	155.3	157.1	159.3	162.3	164.7	166.3	133.3	140.1	146.8	153.6	160.4	167.1	173.9	12	4
12	5	141.4	143.0	145.4	148.4	150.6	152.4	154.1	155.8	157.6	159.8	162.7	165.2	166.8	133.8	140.6	147.3	154.1	160.8	167.6	174.3	12	5
12	6	141.9	143.5	145.9	148.9	151.0	152.9	154.6	156.3	158.1	160.2	163.2	165.6	167.2	134.4	141.1	147.8	154.6	161.3	168.0	174.8	12	6
12	7	142.4	144.0	146.4	149.4	151.5	153.3	155.0	156.7	158.6	160.7	163.7	166.1	167.7	134.9	141.6	148.3	155.0	161.8	168.5	175.2	12	7
12	8	142.9	144.5	146.9	149.8	152.0	153.8	155.5	157.2	159.0	161.1	164.1	166.5	168.1	135.4	142.1	148.8	155.5	162.2	168.9	175.6	12	8
12	9	143.3	144.9	147.3	150.3	152.4	154.2	155.9	157.6	159.4	161.6	164.5	166.9	168.5	135.8	142.5	149.2	155.9	162.6	169.3	176.0	12	9
12	10	143.8	145.3	147.8	150.7	152.8	154.6	156.3	158.0	159.9	162.0	164.9	167.3	168.9	136.3	143.0	149.7	156.3	163.0	169.7	176.4	12	10
12	11	144.2	145.8	148.2	151.1	153.2	155.1	156.7	158.4	160.2	162.4	165.3	167.7	169.3	136.7	143.4	150.1	156.7	163.4	170.1	176.8	12	11
13	0	144.6	146.2	148.6	151.5	153.6	155.4	157.1	158.8	160.6	162.7	165.7	168.1	169.7	137.1	143.8	150.5	157.1	163.8	170.5	177.1	13	0
13	1	144.9	146.5	148.9	151.9	154.0	155.8	157.5	159.2	161.0	163.1	166.0	168.5	170.0	137.5	144.2	150.8	157.5	164.2	170.8	177.5	13	1
13	2	145.3	146.9	149.3	152.2	154.3	156.1	157.8	159.5	161.3	163.4	166.4	168.8	170.4	137.8	144.5	151.2	157.8	164.5	171.2	177.8	13	2
13	3	145.6	147.2	149.6	152.6	154.7	156.5	158.2	159.8	161.7	163.8	166.7	169.1	170.7	138.2	144.8	151.5	158.2	164.8	171.5	178.1	13	3
13	4	145.9	147.5	149.9	152.9	155.0	156.8	158.5	160.2	162.0	164.1	167.0	169.4	171.0	138.5	145.1	151.8	158.5	165.1	171.8	178.5	13	4
13	5	146.2	147.8	150.2	153.2	155.3	157.1	158.8	160.4	162.3	164.4	167.3	169.7	171.3	138.8	145.4	152.1	158.8	165.4	172.1	178.7	13	5
13	6	146.5	148.1	150.5	153.4	155.5	157.3	159.0	160.7	162.5	164.6	167.6	170.0	171.6	139.0	145.7	152.4	159.0	165.7	172.4	179.0	13	6
13	7	146.8	148.3	150.8	153.7	155.8	157.6	159.3	161.0	162.8	164.9	167.8	170.3	171.8	139.3	146.0	152.6	159.3	166.0	172.6	179.3	13	7
13	8	147.0	148.6	151.0	153.9	156.0	157.8	159.5	161.2	163.0	165.1	168.1	170.5	172.1	139.5	146.2	152.9	159.5	166.2	172.9	179.5	13	8
13	9	147.2	148.8	151.2	154.1	156.3	158.1	159.8	161.5	163.3	165.4	168.3	170.7	172.3	139.8	146.4	153.1	159.8	166.4	173.1	179.8	13	9
13	10	147.4	149.0	151.4	154.4	156.5	158.3	160.0	161.7	163.5	165.6	168.5	171.0	172.5	140.0	146.6	153.3	160.0	166.7	173.3	180.0	13	10
13	11	147.6	149.2	151.6	154.6	156.7	158.5	160.2	161.9	163.7	165.8	168.7	171.2	172.7	140.1	146.8	153.5	160.2	166.9	173.5	180.2	13	11

TABLE 4—*Continued*

Age		Centiles												Standard deviations							Age	
Yrs	*Mths*	*3rd*	*5th*	*10th*	*20th*	*30th*	*40th*	*50th*	*60th*	*70th*	*80th*	*90th*	*95th*	*97th*	*−3S.D.*	*−2S.D.*	*−1S.D.*	*MEDIAN*	*+1S.D.*	*+2S.D.*	*+3S.D.*	*Yrs*	*Mths*
14	0	147.8	149.4	151.8	154.7	156.9	158.7	160.4	162.1	163.9	166.0	168.9	171.4	172.9	140.3	147.0	153.7	160.4	167.0	173.7	180.4	14	0
14	1	147.9	149.5	152.0	154.9	157.0	158.8	160.5	162.2	164.0	166.2	169.1	171.5	173.1	140.5	147.2	153.8	160.5	167.2	173.9	180.6	14	1
14	2	148.1	149.7	152.1	155.1	157.2	159.0	160.7	162.4	164.2	166.3	169.3	171.7	173.3	140.6	147.3	154.0	160.7	167.4	174.1	180.8	14	2
14	3	148.2	149.8	152.3	155.2	157.3	159.1	160.8	162.5	164.4	166.5	169.4	171.9	173.5	140.7	147.4	154.1	160.8	167.6	174.3	181.0	14	3
14	4	148.4	149.9	152.4	155.3	157.5	159.3	161.0	162.7	164.5	166.6	169.6	172.0	173.6	140.9	147.6	154.3	161.0	167.7	174.4	181.1	14	4
14	5	148.5	150.1	152.5	155.5	157.6	159.4	161.1	162.8	164.6	166.8	169.7	172.2	173.8	141.0	147.7	154.4	161.1	167.8	174.5	181.3	14	5
14	6	148.6	150.2	152.6	155.6	157.7	159.5	161.2	162.9	164.8	166.9	169.8	172.3	173.9	141.1	147.8	154.5	161.2	168.0	174.7	181.4	14	6
14	7	148.7	150.3	152.7	155.7	157.8	159.6	161.3	163.0	164.9	167.0	170.0	172.4	174.0	141.2	147.9	154.6	161.3	168.1	174.8	181.5	14	7
14	8	148.8	150.4	152.8	155.8	157.9	159.7	161.4	163.2	165.0	167.1	170.1	172.5	174.1	141.3	148.0	154.7	161.4	168.2	174.9	181.6	14	8
14	9	148.9	150.5	152.9	155.9	158.0	159.8	161.5	163.2	165.1	167.2	170.2	172.6	174.2	141.3	148.1	154.8	161.5	168.3	175.0	181.8	14	9
14	10	148.9	150.5	153.0	156.0	158.1	159.9	161.6	163.3	165.2	167.3	170.3	172.7	174.3	141.4	148.1	154.9	161.6	168.4	175.1	181.8	14	10
14	11	149.0	150.6	153.1	156.0	158.2	160.0	161.7	163.4	165.2	167.4	170.4	172.8	174.4	141.5	148.2	155.0	161.7	168.5	175.2	181.9	14	11
15	0	149.1	150.7	153.1	156.1	158.2	160.1	161.8	163.5	165.3	167.5	170.4	172.9	174.5	141.5	148.3	155.0	161.8	168.5	175.3	182.0	15	0
15	1	149.2	150.8	153.2	156.2	158.3	160.1	161.9	163.6	165.4	167.5	170.5	173.0	174.5	141.6	148.4	155.1	161.9	168.6	175.3	182.1	15	1
15	2	149.2	150.8	153.3	156.2	158.4	160.2	161.9	163.6	165.5	167.6	170.6	173.0	174.6	141.7	148.4	155.2	161.9	168.7	175.4	182.2	15	2
15	3	149.3	150.9	153.3	156.3	158.4	160.3	162.0	163.7	165.5	167.7	170.6	173.1	174.7	141.7	148.5	155.2	162.0	168.7	175.5	182.2	15	3
15	4	149.3	150.9	153.4	156.4	158.5	160.3	162.0	163.7	165.6	167.7	170.7	173.1	174.7	141.8	148.5	155.3	162.0	168.8	175.5	182.3	15	4
15	5	149.4	151.0	153.4	156.4	158.5	160.4	162.1	163.8	165.6	167.8	170.7	173.2	174.8	141.9	148.6	155.3	162.1	168.8	175.6	182.3	15	5
15	6	149.5	151.1	153.5	156.5	158.6	160.4	162.1	163.8	165.7	167.8	170.8	173.2	174.8	141.9	148.7	155.4	162.1	168.9	175.6	182.3	15	6
15	7	149.5	151.1	153.6	156.5	158.7	160.5	162.2	163.9	165.7	167.8	170.8	173.2	174.8	142.0	148.7	155.5	162.2	168.9	175.6	182.4	15	7
15	8	149.6	151.2	153.6	156.6	158.7	160.5	162.2	163.9	165.8	167.9	170.8	173.3	174.9	142.1	148.8	155.5	162.2	168.9	175.7	182.4	15	8
15	9	149.7	151.2	153.7	156.6	158.8	160.6	162.3	164.0	165.8	167.9	170.9	173.3	174.9	142.1	148.9	155.6	162.3	169.0	175.7	182.4	15	9
15	10	149.7	151.3	153.7	156.7	158.8	160.6	162.3	164.0	165.8	168.0	170.9	173.3	174.9	142.2	148.9	155.6	162.3	169.0	175.7	182.4	15	10
15	11	149.8	151.4	153.8	156.7	158.9	160.7	162.4	164.1	165.9	168.0	170.9	173.4	174.9	142.3	149.0	155.7	162.4	169.0	175.7	182.4	15	11

TABLE 4—*Continued*

Age		Centiles													Standard deviations							Age	
Yrs	*Mths*	*3rd*	*5th*	*10th*	*20th*	*30th*	*40th*	*50th*	*60th*	*70th*	*80th*	*90th*	*95th*	*97th*	*−3S.D.*	*−2S.D.*	*−1S.D.*	*MEDIAN*	*+1S.D.*	*+2S.D.*	*+3S.D.*	*Yrs*	*Mths*
16	0	149.9	151.4	153.9	156.8	158.9	160.7	162.4	164.1	165.9	168.0	171.0	173.4	175.0	142.4	149.1	155.7	162.4	169.1	175.7	182.4	16	0
16	1	150.0	151.5	153.9	156.9	159.0	160.8	162.5	164.1	165.9	168.1	171.0	173.4	175.0	142.5	149.2	155.8	162.5	169.1	175.8	182.4	16	1
16	2	150.0	151.6	154.0	156.9	159.0	160.8	162.5	164.2	166.0	168.1	171.0	173.4	175.0	142.6	149.3	155.9	162.5	169.1	175.8	182.4	16	2
16	3	150.1	151.7	154.1	157.0	159.1	160.9	162.6	164.2	166.0	168.1	171.0	173.4	175.0	142.8	149.4	156.0	162.6	169.2	175.8	182.4	16	3
16	4	150.2	151.8	154.2	157.1	159.2	160.9	162.6	164.3	166.1	168.2	171.0	173.4	175.0	142.9	149.5	156.0	162.6	169.2	175.8	182.3	16	4
16	5	150.3	151.9	154.3	157.2	159.2	161.0	162.7	164.3	166.1	168.2	171.1	173.4	175.0	143.0	149.6	156.1	162.7	169.2	175.8	182.3	16	5
16	6	150.4	152.0	154.4	157.2	159.3	161.1	162.7	164.4	166.1	168.2	171.1	173.5	175.0	143.2	149.7	156.2	162.7	169.2	175.8	182.3	16	6
16	7	150.6	152.1	154.5	157.3	159.4	161.1	162.8	164.4	166.2	168.2	171.1	173.5	175.0	143.3	149.8	156.3	162.8	169.3	175.8	182.3	16	7
16	8	150.7	152.2	154.5	157.4	159.4	161.2	162.8	164.5	166.2	168.3	171.1	173.5	175.0	143.4	149.9	156.4	162.8	169.3	175.8	182.2	16	8
16	9	150.8	152.3	154.6	157.5	159.5	161.3	162.9	164.5	166.3	168.3	171.1	173.5	175.0	143.6	150.0	156.5	162.9	169.3	175.8	182.2	16	9
16	10	150.9	152.4	154.7	157.6	159.6	161.3	162.9	164.6	166.3	168.3	171.2	173.5	175.0	143.7	150.1	156.5	162.9	169.3	175.8	182.2	16	10
16	11	151.0	152.5	154.8	157.6	159.7	161.4	163.0	164.6	166.3	168.4	171.2	173.5	175.0	143.9	150.3	156.6	163.0	169.4	175.7	182.1	16	11
17	0	151.1	152.6	154.9	157.7	159.7	161.5	163.1	164.7	166.4	168.4	171.2	173.5	175.0	144.1	150.4	156.7	163.1	169.4	175.7	182.1	17	0
17	1	151.3	152.7	155.0	157.8	159.8	161.5	163.1	164.7	166.4	168.4	171.2	173.5	175.0	144.2	150.5	156.8	163.1	169.4	175.7	182.0	17	1
17	2	151.4	152.9	155.1	157.9	159.9	161.6	163.2	164.8	166.5	168.5	171.2	173.5	175.0	144.4	150.6	156.9	163.2	169.4	175.7	182.0	17	2
17	3	151.5	153.0	155.2	158.0	160.0	161.7	163.2	164.8	166.5	168.5	171.2	173.5	175.0	144.5	150.8	157.0	163.2	169.5	175.7	181.9	17	3
17	4	151.6	153.1	155.3	158.1	160.0	161.7	163.3	164.9	166.5	168.5	171.2	173.5	175.0	144.7	150.9	157.1	163.3	169.5	175.7	181.9	17	4
17	5	151.7	153.2	155.4	158.1	160.1	161.8	163.3	164.9	166.6	168.5	171.3	173.5	175.0	144.8	151.0	157.2	163.3	169.5	175.7	181.9	17	5
17	6	151.8	153.3	155.5	158.2	160.2	161.8	163.4	165.0	166.6	168.6	171.3	173.5	174.9	145.0	151.1	157.3	163.4	169.5	175.7	181.8	17	6
17	7	152.0	153.4	155.6	158.3	160.3	161.9	163.5	165.0	166.7	168.6	171.3	173.5	174.9	145.1	151.2	157.3	163.5	169.6	175.7	181.8	17	7
17	8	152.1	153.5	155.7	158.4	160.3	162.0	163.5	165.0	166.7	168.6	171.3	173.5	174.9	145.3	151.4	157.4	163.5	169.6	175.7	181.7	17	8
17	9	152.2	153.6	155.8	158.5	160.4	162.0	163.6	165.1	166.7	168.6	171.3	173.5	174.9	145.4	151.5	157.5	163.6	169.6	175.7	181.7	17	9
17	10	152.3	153.7	155.9	158.5	160.5	162.1	163.6	165.1	166.8	168.7	171.3	173.5	174.9	145.6	151.6	157.6	163.6	169.6	175.6	181.7	17	10
17	11	152.4	153.8	156.0	158.6	160.5	162.1	163.7	165.2	166.8	168.7	171.3	173.5	174.9	145.7	151.7	157.7	163.7	169.7	175.6	181.6	17	11
18	0	152.5	153.9	156.1	158.7	160.6	162.2	163.7	165.2	166.8	168.7	171.4	173.5	174.9	145.8	151.8	157.7	163.7	169.7	175.6	181.6	18	0

TABLE 5

Weight (kg) by Age of Boys aged 0–36 months

Age Months	Centiles												Standard deviations							Age Months
	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	
0	2.5	2.6	2.7	2.9	3.1	3.2	3.3	3.4	3.5	3.7	3.9	4.1	4.2	2.0	2.4	2.9	3.3	3.8	4.3	4.8	0
1	3.0	3.2	3.4	3.7	3.9	4.1	4.3	4.5	4.6	4.9	5.1	5.4	5.6	2.2	2.9	3.6	4.3	5.0	5.6	6.3	1
2	3.6	3.8	4.1	4.5	4.7	5.0	5.2	5.4	5.6	5.9	6.2	6.5	6.7	2.6	3.5	4.3	5.2	6.0	6.8	7.6	2
3	4.2	4.4	4.8	5.2	5.5	5.7	6.0	6.2	6.4	6.7	7.1	7.4	7.6	3.1	4.1	5.0	6.0	6.9	7.7	8.6	3
4	4.8	5.1	5.4	5.8	6.2	6.4	6.7	6.9	7.2	7.5	7.9	8.2	8.4	3.7	4.7	5.7	6.7	7.6	8.5	9.4	4
5	5.4	5.7	6.0	6.5	6.8	7.0	7.3	7.5	7.8	8.1	8.5	8.9	9.1	4.3	5.3	6.3	7.3	8.2	9.2	10.1	5
6	6.0	6.2	6.6	7.0	7.3	7.6	7.8	8.1	8.4	8.7	9.1	9.4	9.7	4.9	5.9	6.9	7.8	8.8	9.8	10.8	6
7	6.5	6.7	7.1	7.5	7.8	8.1	8.3	8.6	8.9	9.2	9.6	10.0	10.2	5.4	6.4	7.4	8.3	9.3	10.3	11.3	7
8	7.0	7.2	7.5	8.0	8.3	8.5	8.8	9.0	9.3	9.6	10.1	10.5	10.7	5.9	6.9	7.8	8.8	9.8	10.8	11.8	8
9	7.4	7.6	7.9	8.4	8.7	8.9	9.2	9.4	9.7	10.1	10.5	10.9	11.1	6.3	7.2	8.2	9.2	10.2	11.3	12.3	9
10	7.7	7.9	8.3	8.7	9.0	9.3	9.5	9.8	10.1	10.4	10.9	11.3	11.5	6.6	7.6	8.6	9.5	10.6	11.7	12.7	10
11	8.0	8.2	8.6	9.0	9.3	9.6	9.9	10.1	10.4	10.8	11.3	11.6	11.9	6.9	7.9	8.9	9.9	10.9	12.0	13.1	11
12	8.2	8.5	8.8	9.3	9.6	9.9	10.2	10.4	10.7	11.1	11.6	12.0	12.2	7.1	8.1	9.1	10.2	11.3	12.4	13.5	12
13	8.5	8.7	9.1	9.5	9.9	10.1	10.4	10.7	11.0	11.4	11.9	12.3	12.5	7.3	8.3	9.4	10.4	11.5	12.7	13.8	13
14	8.7	8.9	9.3	9.8	10.1	10.4	10.7	10.9	11.3	11.6	12.1	12.6	12.8	7.5	8.5	9.6	10.7	11.8	13.0	14.1	14
15	8.8	9.1	9.5	10.0	10.3	10.6	10.9	11.2	11.5	11.9	12.4	12.8	13.1	7.6	8.7	9.8	10.9	12.0	13.2	14.4	15
16	9.0	9.2	9.6	10.1	10.5	10.8	11.1	11.4	11.7	12.1	12.6	13.0	13.3	7.7	8.8	10.0	11.1	12.3	13.5	14.7	16
17	9.1	9.4	9.8	10.3	10.7	11.0	11.3	11.6	11.9	12.3	12.8	13.3	13.6	7.8	9.0	10.1	11.3	12.5	13.7	14.9	17
18	9.3	9.5	10.0	10.5	10.9	11.2	11.5	11.8	12.1	12.5	13.0	13.5	13.8	7.9	9.1	10.3	11.5	12.7	13.9	15.2	18

TABLE 5—*Continued*

Age Months	Centiles													Standard deviations							Age Months
	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	
19	9.4	9.7	10.1	10.6	11.0	11.4	11.7	12.0	12.3	12.7	13.3	13.7	14.0	8.0	9.2	10.5	11.7	12.9	14.1	15.4	19
20	9.5	9.8	10.3	10.8	11.2	11.5	11.8	12.2	12.5	12.9	13.5	13.9	14.2	8.1	9.4	10.6	11.8	13.1	14.4	15.6	20
21	9.7	10.0	10.4	11.0	11.4	11.7	12.0	12.4	12.7	13.1	13.7	14.1	14.4	8.3	9.5	10.8	12.0	13.3	14.6	15.8	21
22	9.8	10.1	10.6	11.1	11.5	11.9	12.2	12.5	12.9	13.3	13.9	14.3	14.6	8.4	9.7	10.9	12.2	13.5	14.8	16.0	22
23	9.9	10.3	10.7	11.3	11.7	12.1	12.4	12.7	13.1	13.5	14.1	14.5	14.8	8.5	9.8	11.1	12.4	13.7	15.0	16.3	23
24	10.1	10.4	10.9	11.5	11.9	12.3	12.6	12.9	13.3	13.7	14.2	14.7	15.0	8.6	9.9	11.3	12.6	13.9	15.2	16.5	24
25	10.2	10.5	11.0	11.6	12.1	12.4	12.8	13.1	13.5	13.9	14.4	14.9	15.2	8.7	10.1	11.4	12.8	14.1	15.4	16.7	25
26	10.4	10.7	11.2	11.8	12.2	12.6	13.0	13.3	13.6	14.1	14.6	15.1	15.4	8.8	10.2	11.6	13.0	14.3	15.6	16.9	26
27	10.5	10.8	11.3	12.0	12.4	12.8	13.1	13.5	13.8	14.2	14.8	15.3	15.6	8.9	10.3	11.7	13.1	14.5	15.8	17.1	27
28	10.6	11.0	11.5	12.1	12.6	13.0	13.3	13.7	14.0	14.4	15.0	15.5	15.8	9.1	10.5	11.9	13.3	14.6	16.0	17.3	28
29	10.8	11.1	11.7	12.3	12.7	13.1	13.5	13.8	14.2	14.6	15.2	15.7	16.0	9.2	10.6	12.1	13.5	14.8	16.2	17.5	29
30	10.9	11.3	11.8	12.4	12.9	13.3	13.7	14.0	14.4	14.8	15.4	15.9	16.2	9.3	10.8	12.2	13.7	15.0	16.4	17.7	30
31	11.1	11.4	12.0	12.6	13.1	13.5	13.8	14.2	14.6	15.0	15.6	16.1	16.4	9.4	10.9	12.4	13.8	15.2	16.6	17.9	31
32	11.2	11.6	12.1	12.8	13.2	13.6	14.0	14.4	14.7	15.2	15.8	16.3	16.6	9.5	11.0	12.5	14.0	15.4	16.8	18.2	32
33	11.3	11.7	12.3	12.9	13.4	13.8	14.2	14.5	14.9	15.4	16.0	16.5	16.8	9.7	11.2	12.7	14.2	15.6	17.0	18.4	33
34	11.5	11.8	12.4	13.1	13.6	14.0	14.4	14.7	15.1	15.6	16.2	16.7	17.0	9.8	11.3	12.8	14.4	15.8	17.2	18.6	34
35	11.6	12.0	12.5	13.2	13.7	14.1	14.5	14.9	15.3	15.7	16.4	16.9	17.3	9.9	11.4	13.0	14.5	16.0	17.4	18.9	35
36	11.8	12.1	12.7	13.4	13.9	14.3	14.7	15.1	15.5	15.9	16.6	17.1	17.5	10.0	11.6	13.1	14.7	16.2	17.7	19.1	36

TABLE 6

Weight (kg) by Age of Boys aged 2–18 years

Age Yrs	Age Mths	Centiles 3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	Standard deviations −3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	Age Yrs	Age Mths
2	0	10.2	10.5	10.9	11.4	11.8	12.1	12.3	12.8	13.2	13.8	14.5	15.1	15.5	9.0	10.1	11.2	12.3	14.0	15.7	17.4	2	0
2	1	10.3	10.6	11.0	11.6	11.9	12.2	12.5	13.0	13.4	14.0	14.7	15.3	15.7	9.0	10.2	11.4	12.5	14.2	15.9	17.6	2	1
2	2	10.4	10.7	11.2	11.7	12.1	12.4	12.7	13.2	13.6	14.2	14.9	15.5	15.9	9.1	10.3	11.5	12.7	14.4	16.1	17.8	2	2
2	3	10.6	10.9	11.3	11.9	12.3	12.6	12.9	13.4	13.8	14.4	15.1	15.7	16.1	9.1	10.4	11.7	12.9	14.6	16.3	18.0	2	3
2	4	10.7	11.0	11.5	12.0	12.4	12.8	13.1	13.6	14.0	14.6	15.3	16.0	16.4	9.2	10.5	11.8	13.1	14.8	16.6	18.3	2	4
2	5	10.8	11.1	11.6	12.2	12.6	13.0	13.3	13.8	14.2	14.8	15.5	16.2	16.6	9.3	10.6	12.0	13.3	15.1	16.8	18.5	2	5
2	6	10.9	11.2	11.7	12.3	12.8	13.2	13.5	14.0	14.4	15.0	15.7	16.4	16.8	9.4	10.7	12.1	13.5	15.3	17.0	18.7	2	6
2	7	11.0	11.4	11.9	12.5	13.0	13.3	13.7	14.1	14.6	15.2	15.9	16.6	17.0	9.4	10.9	12.3	13.7	15.5	17.2	19.0	2	7
2	8	11.1	11.5	12.0	12.7	13.1	13.5	13.9	14.3	14.8	15.4	16.1	16.8	17.2	9.5	11.0	12.4	13.9	15.7	17.4	19.2	2	8
2	9	11.3	11.6	12.2	12.8	13.3	13.7	14.1	14.5	15.0	15.6	16.4	17.0	17.4	9.6	11.1	12.6	14.1	15.9	17.6	19.4	2	9
2	10	11.4	11.7	12.3	13.0	13.5	13.9	14.3	14.7	15.2	15.8	16.6	17.2	17.6	9.7	11.2	12.7	14.3	16.0	17.8	19.6	2	10
2	11	11.5	11.9	12.4	13.1	13.6	14.0	14.4	14.9	15.4	16.0	16.8	17.4	17.8	9.7	11.3	12.9	14.4	16.2	18.0	19.8	2	11
3	0	11.6	12.0	12.6	13.3	13.8	14.2	14.6	15.1	15.6	16.2	17.0	17.6	18.0	9.8	11.4	13.0	14.6	16.4	18.3	20.1	3	0
3	1	11.7	12.1	12.7	13.4	13.9	14.4	14.8	15.3	15.8	16.3	17.2	17.8	18.2	9.9	11.5	13.2	14.8	16.6	18.5	20.3	3	1
3	2	11.9	12.3	12.9	13.6	14.1	14.6	15.0	15.4	15.9	16.5	17.3	18.0	18.5	10.0	11.7	13.3	15.0	16.8	18.7	20.5	3	2
3	3	12.0	12.4	13.0	13.7	14.3	14.7	15.2	15.6	16.1	16.7	17.5	18.2	18.7	10.1	11.8	13.5	15.2	17.0	18.9	20.7	3	3
3	4	12.1	12.5	13.1	13.9	14.4	14.9	15.3	15.8	16.3	16.9	17.7	18.4	18.9	10.2	11.9	13.6	15.3	17.2	19.1	21.0	3	4
3	5	12.2	12.6	13.3	14.0	14.6	15.1	15.5	16.0	16.5	17.1	17.9	18.6	19.1	10.3	12.0	13.8	15.5	17.4	19.3	21.2	3	5
3	6	12.4	12.8	13.4	14.2	14.8	15.2	15.7	16.2	16.7	17.3	18.1	18.8	19.3	10.4	12.1	13.9	15.7	17.6	19.5	21.4	3	6
3	7	12.5	12.9	13.6	14.3	14.9	15.4	15.8	16.3	16.9	17.5	18.3	19.0	19.5	10.5	12.3	14.1	15.8	17.8	19.7	21.7	3	7
3	8	12.6	13.0	13.7	14.5	15.1	15.6	16.0	16.5	17.0	17.7	18.5	19.2	19.7	10.6	12.4	14.2	16.0	18.0	19.9	21.9	3	8
3	9	12.7	13.2	13.8	14.6	15.2	15.7	16.2	16.7	17.2	17.9	18.7	19.4	19.9	10.7	12.5	14.4	16.2	18.2	20.1	22.1	3	9
3	10	12.9	13.3	14.0	14.8	15.4	15.9	16.4	16.9	17.4	18.0	18.9	19.7	20.1	10.8	12.6	14.5	16.4	18.4	20.4	22.4	3	10
3	11	13.0	13.4	14.1	14.9	15.5	16.1	16.5	17.0	17.6	18.2	19.1	19.9	20.3	10.9	12.8	14.6	16.5	18.6	20.6	22.6	3	11

TABLE 6—*Continued*

Age		Centiles												Standard deviations							Age	
Yrs	Mths	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D	+2S.D.	+3S.D	Yrs	Mths
4	0	13.1	13.6	14.3	15.1	15.7	16.2	16.7	17.2	17.8	18.4	19.3	20.1	20.5	11.0	12.9	14.8	16.7	18.7	20.8	22.8	4	0
4	1	13.2	13.7	14.4	15.2	15.9	16.4	16.9	17.4	17.9	18.6	19.5	20.3	20.8	11.1	13.0	14.9	16.9	18.9	21.0	23.1	4	1
4	2	13.4	13.8	14.5	15.4	16.0	16.5	17.0	17.6	18.1	18.8	19.7	20.5	21.0	11.2	13.1	15.1	17.0	19.1	21.2	23.3	4	2
4	3	13.5	14.0	14.7	15.5	16.2	16.7	17.2	17.7	18.3	19.0	19.9	20.7	21.2	11.3	13.3	15.2	17.2	19.3	21.4	23.6	4	3
4	4	13.6	14.1	14.8	15.7	16.3	16.9	17.4	17.9	18.5	19.2	20.1	20.9	21.4	11.4	13.4	15.4	17.4	19.5	21.7	23.8	4	4
4	5	13.8	14.2	15.0	15.8	16.5	17.0	17.5	18.1	18.7	19.4	20.3	21.1	21.6	11.5	13.5	15.5	17.5	19.7	21.9	24.1	4	5
4	6	13.9	14.4	15.1	16.0	16.6	17.2	17.7	18.2	18.8	19.5	20.5	21.3	21.8	11.6	13.7	15.7	17.7	19.9	22.1	24.3	4	6
4	7	14.0	14.5	15.2	16.1	16.8	17.3	17.9	18.4	19.0	19.7	20.7	21.5	22.1	11.8	13.8	15.8	17.9	20.1	22.3	24.6	4	7
4	8	14.2	14.6	15.4	16.3	16.9	17.5	18.0	18.6	19.2	19.9	20.9	21.8	22.3	11.9	13.9	16.0	18.0	20.3	22.6	24.8	4	8
4	9	14.3	14.8	15.5	16.4	17.1	17.7	18.2	18.8	19.4	20.1	21.1	22.0	22.5	12.0	14.0	16.1	18.2	20.5	22.8	25.1	4	9
4	10	14.4	14.9	15.7	16.6	17.3	17.8	18.3	18.9	19.6	20.3	21.3	22.2	22.7	12.1	14.2	16.3	18.3	20.7	23.0	25.4	4	10
4	11	14.6	15.1	15.8	16.7	17.4	18.0	18.5	19.1	19.8	20.5	21.6	22.4	23.0	12.2	14.3	16.4	18.5	20.9	23.3	25.6	4	11
5	0	14.7	15.2	16.0	16.9	17.6	18.1	18.7	19.3	19.9	20.7	21.8	22.6	23.2	12.3	14.4	16.6	18.7	21.1	23.5	25.9	5	0
5	1	14.8	15.3	16.1	17.0	17.7	18.3	18.8	19.5	20.1	20.9	22.0	22.9	23.4	12.4	14.6	16.7	18.8	21.3	23.7	26.2	5	1
5	2	15.0	15.5	16.2	17.2	17.9	18.5	19.0	19.6	20.3	21.1	22.2	23.1	23.7	12.6	14.7	16.9	19.0	21.5	24.0	26.5	5	2
5	3	15.1	15.6	16.4	17.3	18.0	18.6	19.2	19.8	20.5	21.3	22.4	23.3	23.9	12.7	14.8	17.0	19.2	21.7	24.2	26.7	5	3
5	4	15.2	15.7	16.5	17.5	18.2	18.8	19.3	20.0	20.7	21.5	22.6	23.6	24.2	12.8	15.0	17.1	19.3	21.9	24.5	27.0	5	4
5	5	15.4	15.9	16.7	17.6	18.3	18.9	19.5	20.2	20.9	21.7	22.8	23.8	24.4	12.9	15.1	17.3	19.5	22.1	24.7	27.3	5	5
5	6	15.5	16.0	16.8	17.8	18.5	19.1	19.7	20.3	21.1	21.9	23.1	24.0	24.7	13.0	15.2	17.4	19.7	22.3	25.0	27.6	5	6
5	7	15.6	16.2	17.0	18.0	18.7	19.3	19.8	20.5	21.2	22.1	23.3	24.3	24.9	13.1	15.4	17.6	19.8	22.5	25.2	27.9	5	7
5	8	15.8	16.3	17.1	18.1	18.8	19.4	20.0	20.7	21.4	22.3	23.5	24.5	25.2	13.2	15.5	17.7	20.0	22.7	25.5	28.2	5	8
5	9	15.9	16.4	17.3	18.3	19.0	19.6	20.2	20.9	21.6	22.5	23.7	24.8	25.4	13.4	15.6	17.9	20.2	23.0	25.7	28.5	5	9
5	10	16.0	16.6	17.4	18.4	19.1	19.8	20.3	21.1	21.8	22.7	24.0	25.0	25.7	13.5	15.8	18.0	20.3	23.2	26.0	28.9	5	10
5	11	16.2	16.7	17.5	18.6	19.3	19.9	20.5	21.2	22.0	22.9	24.2	25.3	25.9	13.6	15.9	18.2	20.5	23.4	26.3	29.2	5	11

TABLE 6—*Continued*

Age		Centiles												Standard deviations							Age	
Yrs	Mths	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	Yrs	Mths
6	0	16.3	16.8	17.7	18.7	19.5	20.1	20.7	21.4	22.2	23.2	24.5	25.5	26.2	13.7	16.0	18.4	20.7	23.6	26.6	29.5	6	0
6	1	16.4	17.0	17.8	18.9	19.6	20.3	20.9	21.6	22.4	23.4	24.7	25.8	26.5	13.8	16.2	18.5	20.9	23.8	26.8	29.8	6	1
6	2	16.6	17.1	18.0	19.0	19.8	20.4	21.0	21.8	22.6	23.6	24.9	26.0	26.8	13.9	16.3	18.7	21.0	24.1	27.1	30.2	6	2
6	3	16.7	17.3	18.1	19.2	20.0	20.6	21.2	22.0	22.8	23.8	25.2	26.3	27.0	14.0	16.4	18.8	21.2	24.3	27.4	30.5	6	3
6	4	16.8	17.4	18.3	19.3	20.1	20.8	21.4	22.2	23.0	24.0	25.4	26.6	27.3	14.1	16.5	19.0	21.4	24.5	27.7	30.9	6	4
6	5	17.0	17.5	18.4	19.5	20.3	20.9	21.6	22.4	23.2	24.3	25.7	26.9	27.6	14.2	16.7	19.1	21.6	24.8	28.0	31.2	6	5
6	6	17.1	17.7	18.6	19.7	20.4	21.1	21.7	22.6	23.5	24.5	25.9	27.1	27.9	14.3	16.8	19.3	21.7	25.0	28.3	31.6	6	6
6	7	17.2	17.8	18.7	19.8	20.6	21.3	21.9	22.8	23.7	24.7	26.2	27.4	28.2	14.4	16.9	19.4	21.9	25.3	28.6	31.9	6	7
6	8	17.4	18.0	18.9	20.0	20.8	21.5	22.1	23.0	23.9	25.0	26.5	27.7	28.5	14.6	17.1	19.6	22.1	25.5	28.9	32.3	6	8
6	9	17.5	18.1	19.0	20.1	21.0	21.6	22.3	23.2	24.1	25.2	26.7	28.0	28.8	14.7	17.2	19.7	22.3	25.8	29.2	32.7	6	9
6	10	17.6	18.2	19.2	20.3	21.1	21.8	22.5	23.4	24.3	25.5	27.0	28.3	29.1	14.8	17.3	19.9	22.5	26.0	29.5	33.1	6	10
6	11	17.8	18.4	19.3	20.5	21.3	22.0	22.7	23.6	24.6	25.7	27.3	28.6	29.4	14.9	17.5	20.1	22.7	26.3	29.9	33.5	6	11
7	0	17.9	18.5	19.5	20.6	21.5	22.2	22.9	23.8	24.8	25.9	27.6	28.9	29.8	15.0	17.6	20.2	22.9	26.5	30.2	33.9	7	0
7	1	18.0	18.7	19.6	20.8	21.6	22.4	23.0	24.0	25.0	26.2	27.8	29.2	30.1	15.1	17.7	20.4	23.0	26.8	30.5	34.3	7	1
7	2	18.2	18.8	19.8	21.0	21.8	22.6	23.2	24.2	25.2	26.5	28.1	29.5	30.4	15.1	17.8	20.5	23.2	27.1	30.9	34.7	7	2
7	3	18.3	18.9	19.9	21.1	22.0	22.7	23.4	24.4	25.5	26.7	28.4	29.8	30.8	15.2	18.0	20.7	23.4	27.3	31.2	35.1	7	3
7	4	18.4	19.1	20.1	21.3	22.2	22.9	23.6	24.6	25.7	27.0	28.7	30.2	31.1	15.3	18.1	20.9	23.6	27.6	31.6	35.5	7	4
7	5	18.6	19.2	20.2	21.5	22.4	23.1	23.8	24.9	26.0	27.2	29.0	30.5	31.5	15.4	18.2	21.0	23.8	27.9	31.9	36.0	7	5
7	6	18.7	19.4	20.4	21.6	22.5	23.3	24.0	25.1	26.2	27.5	29.3	30.8	31.8	15.5	18.4	21.2	24.0	28.2	32.3	36.4	7	6
7	7	18.8	19.5	20.5	21.8	22.7	23.5	24.2	25.3	26.4	27.8	29.6	31.2	32.2	15.6	18.5	21.4	24.2	28.5	32.7	36.9	7	7
7	8	18.9	19.6	20.7	22.0	22.9	23.7	24.4	25.5	26.7	28.1	30.0	31.5	32.5	15.7	18.6	21.5	24.4	28.7	33.0	37.3	7	8
7	9	19.1	19.8	20.9	22.2	23.1	23.9	24.7	25.8	27.0	28.3	30.3	31.9	32.9	15.8	18.7	21.7	24.7	29.0	33.4	37.8	7	9
7	10	19.2	19.9	21.0	22.3	23.3	24.1	24.9	26.0	27.2	28.6	30.6	32.2	33.3	15.8	18.9	21.9	24.9	29.3	33.8	38.3	7	10
7	11	19.3	20.1	21.2	22.5	23.5	24.3	25.1	26.2	27.5	28.9	30.9	32.6	33.7	15.9	19.0	22.0	25.1	29.6	34.2	38.8	7	11

TABLE 6—*Continued*

Age		Centiles												Standard deviations							Age	
Yrs	*Mths*	*3rd*	*5th*	*10th*	*20th*	*30th*	*40th*	*50th*	*60th*	*70th*	*80th*	*90th*	*95th*	*97th*	*−3S.D.*	*−2S.D.*	*−1S.D.*	*MEDIAN*	*+1S.D.*	*+2S.D.*	*+3S.D.*	*Yrs*	*Mths*
8	0	19.5	20.2	21.3	22.7	23.7	24.5	25.3	26.5	27.7	29.2	31.3	33.0	34.1	16.0	19.1	22.2	25.3	30.0	34.6	39.3	8	0
8	1	19.6	20.3	21.5	22.9	23.9	24.7	25.5	26.7	28.0	29.5	31.6	33.3	34.5	16.1	19.2	22.4	25.5	30.3	35.0	39.8	8	1
8	2	19.7	20.5	21.6	23.0	24.1	24.9	25.7	27.0	28.3	29.8	32.0	33.7	34.9	16.1	19.3	22.5	25.7	30.6	35.4	40.3	8	2
8	3	19.8	20.6	21.8	23.2	24.3	25.1	26.0	27.2	28.6	30.1	32.3	34.1	35.3	16.2	19.5	22.7	26.0	30.9	35.9	40.8	8	3
8	4	20.0	20.8	22.0	23.4	24.5	25.4	26.2	27.5	28.8	30.4	32.7	34.5	35.7	16.3	19.6	22.9	26.2	31.2	36.3	41.3	8	4
8	5	20.1	20.9	22.1	23.6	24.7	25.6	26.4	27.7	29.1	30.8	33.0	34.9	36.1	16.3	19.7	23.1	26.4	31.6	36.7	41.9	8	5
8	6	20.2	21.0	22.3	23.8	24.9	25.8	26.7	28.0	29.4	31.1	33.4	35.3	36.5	16.4	19.8	23.2	26.7	31.9	37.2	42.4	8	6
8	7	20.4	21.2	22.4	24.0	25.1	26.0	26.9	28.3	29.7	31.4	33.8	35.7	37.0	16.5	19.9	23.4	26.9	32.3	37.6	43.0	8	7
8	8	20.5	21.3	22.6	24.2	25.3	26.2	27.1	28.5	30.0	31.7	34.1	36.1	37.4	16.5	20.1	23.6	27.1	32.6	38.1	43.5	8	8
8	9	20.6	21.5	22.8	24.4	25.5	26.5	27.4	28.8	30.3	32.1	34.5	36.5	37.9	16.6	20.2	23.8	27.4	32.9	38.5	44.1	8	9
8	10	20.7	21.6	22.9	24.5	25.7	26.7	27.6	29.1	30.6	32.4	34.9	37.0	38.3	16.6	20.3	24.0	27.6	33.3	39.0	44.7	8	10
8	11	20.9	21.7	23.1	24.7	25.9	26.9	27.9	29.3	30.9	32.8	35.3	37.4	38.8	16.7	20.4	24.2	27.9	33.7	39.5	45.2	8	11
9	0	21.0	21.9	23.3	24.9	26.1	27.2	28.1	29.6	31.2	33.1	35.7	37.8	39.2	16.8	20.5	24.3	28.1	34.0	39.9	45.8	9	0
9	1	21.1	22.0	23.4	25.1	26.4	27.4	28.4	29.9	31.5	33.4	36.1	38.3	39.7	16.8	20.7	24.5	28.4	34.4	40.4	46.4	9	1
9	2	21.3	22.2	23.6	25.3	26.6	27.7	28.6	30.2	31.9	33.8	36.5	38.7	40.2	16.9	20.8	24.7	28.6	34.8	40.9	47.0	9	2
9	3	21.4	22.3	23.8	25.5	26.8	27.9	28.9	30.5	32.2	34.2	36.9	39.2	40.6	16.9	20.9	24.9	28.9	35.2	41.4	47.6	9	3
9	4	21.5	22.5	24.0	25.8	27.0	28.2	29.2	30.8	32.5	34.5	37.3	39.6	41.1	17.0	21.0	25.1	29.2	35.5	41.9	48.2	9	4
9	5	21.7	22.6	24.1	26.0	27.3	28.4	29.5	31.1	32.8	34.9	37.7	40.1	41.6	17.0	21.2	25.3	29.5	35.9	42.4	48.9	9	5
9	6	21.8	22.8	24.3	26.2	27.5	28.7	29.7	31.4	33.2	35.3	38.2	40.6	42.1	17.1	21.3	25.5	29.7	36.3	42.9	49.5	9	6
9	7	22.0	23.0	24.5	26.4	27.8	28.9	30.0	31.7	35.5	35.6	38.6	41.0	42.6	17.2	21.4	25.7	30.0	36.7	43.4	50.1	9	7
9	8	22.1	23.1	24.7	26.6	28.0	29.2	30.3	32.0	33.9	36.0	39.0	41.5	43.1	17.2	21.6	25.9	30.3	37.1	43.9	50.7	9	8
9	9	22.2	23.3	24.9	26.8	28.2	29.4	30.6	32.3	34.2	36.4	39.5	42.0	43.6	17.3	21.7	26.1	30.6	37.5	44.4	51.4	9	9
9	10	22.4	23.5	25.1	27.1	28.5	29.7	30.9	32.6	34.6	36.8	39.9	42.5	44.1	17.4	21.9	26.4	30.9	37.9	45.0	52.0	9	10
9	11	22.5	23.6	25.3	27.3	28.7	30.0	31.1	33.0	34.9	37.2	40.3	43.0	44.6	17.4	22.0	26.6	31.1	38.3	45.5	52.7	9	11

TABLE 6—*Continued*

Age		Centiles												Standard deviations							Age	
Yrs	Mths	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	Yrs	Mths
10	0	22.7	23.8	25.5	27.5	29.0	30.3	31.4	33.3	35.3	37.6	40.8	43.4	45.2	17.5	22.1	26.8	31.4	38.7	46.0	53.3	10	0
10	1	22.9	24.0	25.7	27.8	29.3	30.5	31.7	33.6	35.6	38.0	41.2	43.9	45.7	17.6	22.3	27.0	31.7	39.2	46.6	54.0	10	1
10	2	23.0	24.1	25.9	28.0	29.5	30.8	32.0	34.0	36.0	38.4	41.7	44.4	46.2	17.6	22.4	27.2	32.0	39.6	47.1	54.6	10	2
10	3	23.2	24.3	26.1	28.2	29.8	31.1	32.4	34.3	36.4	38.8	42.2	44.9	46.8	17.7	22.6	27.5	32.4	40.0	47.7	55.3	10	3
10	4	23.3	24.5	26.3	28.5	30.1	31.4	32.7	34.6	36.7	39.2	42.6	45.5	47.3	17.8	22.8	27.7	32.7	40.4	48.2	56.0	10	4
10	5	23.5	24.7	26.5	28.7	30.3	31.7	33.0	35.0	37.1	39.6	43.1	46.0	47.8	17.9	22.9	27.9	33.0	40.9	48.8	56.7	10	5
10	6	23.7	24.9	26.7	29.0	30.6	32.0	33.3	35.3	37.5	40.0	43.6	46.5	48.4	18.0	23.1	28.2	33.3	41.3	49.3	57.3	10	6
10	7	23.9	25.1	27.0	29.3	30.9	32.3	33.6	35.7	37.9	40.5	44.0	47.0	48.9	18.1	23.2	28.4	33.6	41.8	49.9	58.0	10	7
10	8	24.0	25.3	27.2	29.5	31.2	32.6	33.9	36.0	38.3	40.9	44.5	47.5	49.5	18.1	23.4	28.7	33.9	42.2	50.4	58.7	10	8
10	9	24.2	25.5	27.4	29.8	31.5	32.9	34.3	36.4	38.7	41.3	45.0	48.0	50.0	18.2	23.6	28.9	34.3	42.6	51.0	59.4	10	9
10	10	24.4	25.7	27.7	30.1	31.8	33.2	34.6	36.8	39.1	41.8	45.5	48.6	50.6	18.3	23.8	29.2	34.6	43.1	51.6	60.1	10	10
10	11	24.6	25.9	27.9	30.3	32.1	33.6	35.0	37.1	39.5	42.2	46.0	49.1	51.1	18.5	24.0	29.5	35.0	43.6	52.2	60.8	10	11
11	0	24.8	26.1	28.1	30.6	32.4	33.9	35.3	37.5	39.9	42.6	46.5	49.6	51.7	18.6	24.1	29.7	35.3	44.0	52.7	61.5	11	0
11	1	25.0	26.3	28.4	30.9	32.7	34.2	35.6	37.9	40.3	43.1	47.0	50.2	52.3	18.7	24.3	30.0	35.6	44.5	53.3	62.2	11	1
11	2	25.2	26.6	28.7	31.2	33.0	34.5	36.0	38.3	40.7	43.5	47.5	50.7	52.8	18.8	24.5	30.3	36.0	45.0	53.9	62.9	11	2
11	3	25.4	26.8	28.9	31.5	33.3	34.9	36.4	38.7	41.1	44.0	48.0	51.3	53.4	18.9	24.7	30.5	36.4	45.4	54.5	63.6	11	3
11	4	25.6	27.0	29.2	31.8	33.6	35.2	36.7	39.0	41.5	44.4	48.5	51.8	54.0	19.0	24.9	30.8	36.7	45.9	55.1	64.3	11	4
11	5	25.9	27.3	29.4	32.1	34.0	35.6	37.1	39.4	42.0	44.9	49.0	52.4	54.6	19.2	25.2	31.1	37.1	46.4	55.7	65.0	11	5
11	6	26.1	27.5	29.7	32.4	34.3	35.9	37.5	39.8	42.4	45.4	49.5	52.9	55.1	19.3	25.4	31.4	37.5	46.9	56.3	65.7	11	6
11	7	26.3	27.8	30.0	32.7	34.6	36.3	37.8	40.2	42.8	45.8	50.0	53.5	55.7	19.5	25.6	31.7	37.8	47.3	56.9	66.4	11	7
11	8	26.6	28.0	30.3	33.0	35.0	36.6	38.2	40.6	43.3	46.3	50.5	54.0	56.3	19.6	25.8	32.0	38.2	47.8	57.5	67.1	11	8
11	9	26.8	28.3	30.6	33.3	35.3	37.0	38.6	41.1	43.7	46.8	51.1	54.6	56.9	19.8	26.1	32.3	38.6	48.3	58.1	67.8	11	9
11	10	27.0	28.5	30.9	33.6	35.7	37.4	39.0	41.5	44.1	47.3	51.6	55.2	57.5	19.9	26.3	32.6	39.0	48.8	58.7	68.5	10	10
11	11	27.3	28.8	31.2	34.0	36.0	37.8	39.4	41.9	44.6	47.7	52.1	55.7	58.1	20.1	26.5	33.0	39.4	49.3	59.3	69.2	11	11

TABLE 6—*Continued*

Age		Centiles												Standard deviations							Age	
Yrs	Mths	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D	+2S.D.	+3S.D.	Yrs	Mths
12	0	27.6	29.1	31.5	34.3	36.4	38.1	39.8	42.3	45.0	48.2	52.6	56.3	58.7	20.3	26.8	33.3	39.8	49.8	59.9	69.9	12	0
12	1	27.8	29.4	31.8	34.7	36.7	38.5	40.2	42.8	45.5	48.7	53.2	56.9	59.3	20.5	27.1	33.6	40.2	50.3	60.5	70.6	12	1
12	2	28.1	29.7	32.1	35.0	37.1	38.9	40.6	43.2	46.0	49.2	53.7	57.4	59.9	20.7	27.3	34.0	40.6	50.8	61.1	71.3	12	2
12	3	28.4	30.0	32.4	35.4	37.5	39.3	41.0	43.6	46.4	49.7	54.3	58.0	60.5	20.9	27.6	34.3	41.0	51.3	61.7	72.0	12	3
12	4	28.7	30.3	32.7	35.7	37.9	39.7	41.4	44.1	46.9	50.2	54.8	58.6	61.1	21.1	27.9	34.6	41.4	51.9	62.3	72.7	12	4
12	5	29.0	30.6	33.1	36.1	38.3	40.1	41.8	44.5	47.4	50.7	55.3	59.2	61.7	21.3	28.2	35.0	41.8	52.4	62.9	73.4	12	5
12	6	29.3	30.9	33.4	36.5	38.6	40.5	42.3	45.0	47.8	51.2	55.9	59.8	62.3	21.5	28.4	35.4	42.3	52.9	63.5	74.1	12	6
12	7	29.6	31.2	33.8	36.8	39.0	40.9	42.7	45.4	48.3	51.7	56.4	60.3	62.9	21.8	28.7	35.7	42.7	53.4	64.1	74.9	12	7
12	8	29.9	31.6	34.1	37.2	39.4	41.4	43.1	45.9	48.8	52.2	57.0	60.9	63.5	22.0	29.0	36.1	43.1	53.9	64.8	75.6	12	8
12	9	30.2	31.9	34.5	37.6	39.9	41.8	43.6	46.3	49.3	52.8	57.5	61.5	64.1	22.3	29.4	36.5	43.6	54.5	65.4	76.3	12	9
12	10	30.5	32.2	34.8	38.0	40.3	42.2	44.0	46.8	49.8	53.3	58.1	62.1	64.7	22.5	29.7	36.9	44.0	55.0	66.0	77.0	12	10
12	11	30.9	32.6	35.2	38.4	40.7	42.7	44.5	47.3	50.3	53.8	58.7	62.7	65.3	22.8	30.0	37.3	44.5	55.5	66.6	77.7	12	11
13	0	31.2	32.9	35.6	38.8	41.1	43.1	45.0	47.8	50.8	54.3	59.2	63.3	65.9	23.1	30.4	37.7	45.0	56.1	67.2	78.3	13	0
13	1	31.6	33.3	36.0	39.2	41.6	43.6	45.4	48.3	51.3	54.9	59.8	63.9	66.5	23.3	30.7	38.1	45.4	56.6	67.8	79.0	13	1
13	2	31.9	33.7	36.4	39.6	42.0	44.0	45.9	48.7	51.8	55.4	60.3	64.4	67.1	23.6	31.1	38.5	45.9	57.2	68.5	79.7	13	2
13	3	32.3	34.1	36.8	40.1	42.4	44.5	46.4	49.2	52.3	55.9	60.9	65.0	67.7	23.9	31.4	38.9	46.4	57.7	69.1	80.4	13	3
13	4	32.7	34.5	37.2	40.5	42.9	44.9	46.8	49.7	52.8	56.5	61.5	65.6	68.3	24.2	31.8	39.3	46.8	58.3	69.7	81.1	13	4
13	5	33.1	34.8	37.6	40.9	43.3	45.4	47.3	50.2	53.3	57.0	62.0	66.2	68.9	24.6	32.2	39.7	47.3	58.8	70.3	81.8	13	5
13	6	33.4	35.2	38.0	41.4	43.8	45.9	47.8	50.7	53.9	57.5	62.6	66.8	69.5	24.9	32.5	40.2	47.8	59.4	70.9	82.5	13	6
13	7	33.8	35.6	38.4	41.8	44.3	46.3	48.3	51.2	54.4	58.1	63.2	67.4	70.2	25.2	32.9	40.6	48.3	59.9	71.5	83.2	13	7
13	8	34.2	36.1	38.9	42.3	44.7	46.8	48.8	51.7	54.9	58.6	63.8	68.0	70.8	25.6	33.3	41.0	48.8	60.5	72.1	83.8	13	8
13	9	34.6	36.5	39.3	42.7	45.2	47.3	49.3	52.3	55.4	59.2	64.3	68.6	71.4	25.9	33.7	41.5	49.3	61.0	72.8	84.5	13	9
13	10	35.0	36.9	39.7	43.2	45.7	47.8	49.8	52.8	56.0	59.7	64.9	69.2	72.0	26.3	34.1	41.9	49.8	61.6	73.4	85.2	13	10
13	11	35.4	37.3	40.2	43.6	46.1	48.3	50.3	53.3	56.5	60.2	65.5	69.8	72.6	26.6	34.5	42.4	50.3	62.1	74.0	85.8	13	11

TABLE 6—*Continued*

Age		Centiles												Standard deviations							Age	
Yrs	Mths	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	Yrs	Mths
14	0	35.9	37.7	40.6	44.1	46.6	48.8	50.8	53.8	57.0	60.8	66.0	70.4	73.2	27.0	34.9	42.8	50.8	62.7	74.6	86.5	14	0
14	1	36.3	38.2	41.1	44.6	47.1	49.3	51.3	54.3	57.5	61.3	66.6	70.9	73.8	27.4	35.3	43.3	51.3	63.2	75.2	87.1	14	1
14	2	36.7	38.6	41.5	45.0	47.6	49.7	51.8	54.8	58.1	61.9	67.2	71.5	74.4	27.7	35.7	43.8	51.8	63.8	75.8	87.8	14	2
14	3	37.1	39.0	41.9	45.5	48.0	50.2	52.3	55.3	58.6	62.4	67.7	72.1	75.0	28.1	36.2	44.2	52.3	64.3	76.4	88.4	14	3
14	4	37.5	39.4	42.4	46.0	48.5	50.7	52.8	55.8	59.1	63.0	68.3	72.7	75.5	28.5	36.6	44.7	52.8	64.9	77.0	89.1	14	4
14	5	38.0	39.9	42.8	46.4	49.0	51.2	53.3	56.3	59.6	63.5	68.8	73.3	76.1	28.9	37.0	45.1	53.3	65.4	77.6	89.7	14	5
14	6	38.4	40.3	43.3	46.9	49.5	51.7	53.8	56.9	60.2	64.0	69.4	73.8	76.7	29.2	37.4	45.6	53.8	66.0	78.2	90.4	14	6
14	7	38.8	40.7	43.7	47.3	50.0	52.2	54.3	57.4	60.7	64.6	70.0	74.4	77.3	29.6	37.8	46.0	54.3	66.5	78.8	91.0	14	7
14	8	39.2	41.2	44.2	47.8	50.4	52.7	54.8	57.9	61.2	65.1	70.5	75.0	77.9	30.0	38.3	46.5	54.8	67.0	79.3	91.6	14	8
14	9	39.7	41.6	44.6	48.3	50.9	53.1	55.2	58.4	61.7	65.6	71.1	75.5	78.4	30.4	38.7	47.0	55.2	67.6	79.9	92.2	14	9
14	10	40.1	42.1	45.1	48.7	51.4	53.6	55.7	58.9	62.2	66.2	71.6	76.1	79.0	30.8	39.1	47.4	55.7	68.1	80.5	92.9	14	10
14	11	40.5	42.5	45.5	49.2	51.8	54.1	56.2	59.4	62.7	66.7	72.1	76.6	79.6	31.2	39.5	47.9	56.2	68.6	81.1	93.5	14	11
15	0	40.9	42.9	46.0	49.6	52.3	54.6	56.7	59.9	63.2	67.2	72.7	77.2	80.1	31.6	39.9	48.3	56.7	69.2	81.6	94.1	15	0
15	1	41.4	43.3	46.4	50.1	52.8	55.1	57.2	60.4	63.7	67.7	73.2	77.7	80.7	31.9	40.4	48.8	57.2	69.7	82.2	94.7	15	1
15	2	41.8	43.8	46.8	50.6	53.2	55.5	57.7	60.8	64.2	68.2	73.7	78.3	81.2	32.3	40.8	49.2	57.7	70.2	82.7	95.3	15	2
15	3	42.2	44.2	47.3	51.0	53.7	56.0	58.1	61.3	64.7	68.7	74.2	78.8	81.8	32.7	41.2	49.7	58.1	70.7	83.3	95.9	15	3
15	4	42.6	44.6	47.7	51.4	54.1	56.4	58.6	61.8	65.2	69.2	74.8	79.3	82.3	33.1	41.6	50.1	58.6	71.2	83.8	96.4	15	4
15	5	43.0	45.0	48.1	51.9	54.6	56.9	59.1	62.3	65.7	69.7	75.3	79.9	82.9	33.5	42.0	50.5	59.1	71.7	84.4	97.0	15	5
15	6	43.4	45.4	48.5	52.3	55.0	57.3	59.5	62.7	66.2	70.2	75.8	80.4	83.4	33.8	42.4	51.0	59.5	72.2	84.9	97.6	15	6
15	7	43.8	45.8	49.0	52.7	55.5	57.8	60.0	63.2	66.6	70.7	76.3	80.9	83.9	34.2	42.8	51.4	60.0	72.7	85.4	98.2	15	7
15	8	44.2	46.2	49.4	53.2	55.9	58.2	60.4	63.6	67.1	71.2	76.8	81.4	84.4	34.6	43.2	51.8	60.4	73.2	85.9	98.7	15	8
15	9	44.6	46.6	49.8	53.6	56.3	58.7	60.8	64.1	67.6	71.6	77.3	81.9	84.9	35.0	43.6	52.2	60.8	73.6	86.5	99.3	15	9
15	10	45.0	47.0	50.2	54.0	56.7	59.1	61.3	64.5	68.0	72.1	77.7	82.4	85.4	35.3	44.0	52.6	61.3	74.1	87.0	99.8	15	10
15	11	45.4	47.4	50.6	54.4	57.1	59.5	61.7	65.0	68.4	72.5	78.2	82.9	85.9	35.7	44.3	53.0	61.7	74.6	87.5	100.3	15	11

TABLE 6—*Continued*

Age		Centiles												Standard deviations							Age	
Yrs	Mths	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	Yrs	Mths
16	0	45.7	47.8	51.0	54.8	57.5	59.9	62.1	65.4	68.9	73.0	78.7	83.4	86.4	36.0	44.7	53.4	62.1	75.0	87.9	100.9	16	0
16	1	46.1	48.2	51.3	55.2	57.9	60.3	62.5	65.8	69.3	73.4	79.1	83.8	86.9	36.4	45.1	53.8	62.5	75.5	88.4	101.4	16	1
16	2	46.5	48.5	51.7	55.6	58.3	60.7	62.9	66.2	69.7	73.8	79.6	84.3	87.4	36.7	45.4	54.2	62.9	75.9	88.9	101.9	16	2
16	3	46.8	48.9	52.1	55.9	58.7	61.1	63.3	66.6	70.1	74.3	80.0	84.7	87.8	37.0	45.8	54.5	63.3	76.3	89.4	102.4	16	3
16	4	47.2	49.2	52.4	56.3	59.1	61.4	63.7	67.0	70.5	74.7	80.4	85.2	88.3	37.4	46.1	54.9	63.7	76.8	89.8	102.9	16	4
16	5	47.5	49.6	52.8	56.6	59.4	61.8	64.0	67.4	70.9	75.1	80.9	85.6	88.7	37.7	46.5	55.3	64.0	77.2	90.3	103.4	16	5
16	6	47.8	49.9	53.1	57.0	59.8	62.2	64.4	67.7	71.3	75.5	81.3	86.1	89.2	38.0	46.8	55.6	64.4	77.6	90.7	103.9	16	6
16	7	48.2	50.2	53.4	57.3	60.1	62.5	64.7	68.1	71.7	75.9	81.7	86.5	89.6	38.3	47.1	55.9	64.7	78.0	91.2	104.4	16	7
16	8	48.5	50.6	53.8	57.6	60.4	62.8	65.1	68.4	72.0	76.2	82.1	86.9	90.0	38.6	47.4	56.2	65.1	78.3	91.6	104.8	16	8
16	9	48.8	50.9	54.1	58.0	60.8	63.2	65.4	68.8	72.4	76.6	82.5	87.3	90.4	38.9	47.7	56.6	65.4	78.7	92.0	105.3	16	9
16	10	49.1	51.2	54.4	58.3	61.1	63.5	65.7	69.1	72.7	77.0	82.8	87.7	90.8	39.2	48.0	56.9	65.7	79.1	92.4	105.8	16	10
16	11	49.3	51.4	54.7	58.6	61.4	63.8	66.0	69.4	73.0	77.3	83.2	88.1	91.2	39.4	48.3	57.2	66.0	79.4	92.8	106.2	16	11
17	0	49.6	51.7	54.9	58.8	61.7	64.1	66.3	69.7	73.4	77.6	83.5	88.4	91.6	39.7	48.6	57.4	66.3	79.8	93.2	106.6	17	0
17	1	49.9	52.0	55.2	59.1	61.9	64.3	66.6	70.0	73.7	77.9	83.9	88.8	92.0	39.9	48.8	57.7	66.6	80.1	93.6	107.1	17	1
17	2	50.1	52.2	55.4	59.4	62.2	64.6	66.8	70.3	74.0	78.3	84.2	89.1	92.3	40.2	49.1	57.9	66.8	80.4	93.9	107.5	17	2
17	3	50.3	52.4	55.7	59.6	62.4	64.8	67.1	70.5	74.2	78.5	84.5	89.5	92.7	40.4	49.3	58.2	67.1	80.7	94.3	107.9	17	3
17	4	50.6	52.7	55.9	59.8	62.7	65.1	67.3	70.8	74.5	78.8	84.8	89.8	93.0	40.6	49.5	58.4	67.3	81.0	94.6	108.3	17	4
17	5	50.8	52.9	56.1	60.1	62.9	65.3	67.6	71.0	74.8	79.1	85.1	90.1	93.4	40.8	49.7	58.6	67.6	81.3	95.0	108.7	17	5
17	6	51.0	53.1	56.3	60.3	63.1	65.5	67.8	71.3	75.0	79.4	85.4	90.4	93.7	41.0	49.9	58.9	67.8	81.5	95.3	109.1	17	6
17	7	51.2	53.3	56.5	60.5	63.3	65.7	68.0	71.5	75.2	79.6	85.7	90.7	94.0	41.2	50.1	59.0	68.0	81.8	95.6	109.4	17	7
17	8	51.3	53.5	56.7	60.7	63.5	65.9	68.2	71.7	75.5	79.9	86.0	91.0	94.3	41.3	50.3	59.2	68.2	82.1	95.9	109.8	17	8
17	9	51.5	53.6	56.9	60.8	63.7	66.1	68.4	71.9	75.7	80.1	86.2	91.3	94.6	41.5	50.5	59.4	68.4	82.3	96.2	110.1	17	9
17	10	51.7	53.8	57.1	61.0	63.9	66.3	68.6	72.1	75.9	80.3	86.5	91.5	94.8	41.6	50.6	59.6	68.6	82.5	96.5	110.5	17	10
17	11	51.8	54.0	57.2	61.2	64.0	66.4	68.7	72.3	76.1	80.5	86.7	91.8	95.1	41.8	50.8	59.7	68.7	82.7	96.8	110.8	17	11
18	0	52.0	54.1	57.4	61.3	64.2	66.6	68.9	72.4	76.3	80.7	86.9	92.0	95.3	41.9	50.9	59.9	68.9	82.9	97.0	111.1	18	0

TABLE 7

Weight (kg) by Age of Girls aged 0–36 months

Age Months	Centiles												Standard deviations							Age Months
	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	
0	2.3	2.4	2.6	2.8	3.0	3.1	3.2	3.3	3.4	3.5	3.7	3.8	3.9	1.8	2.2	2.7	3.2	3.6	4.0	4.3	0
1	2.9	3.0	3.2	3.5	3.7	3.8	4.0	4.1	4.3	4.4	4.7	4.9	5.0	2.2	2.8	3.4	4.0	4.5	5.1	5.6	1
2	3.4	3.6	3.8	4.1	4.4	4.5	4.7	4.9	5.1	5.3	5.6	5.8	6.0	2.7	3.3	4.0	4.7	5.4	6.1	6.7	2
3	4.0	4.2	4.4	4.8	5.0	5.2	5.4	5.6	5.8	6.1	6.4	6.7	6.9	3.2	3.9	4.7	5.4	6.2	7.0	7.7	3
4	4.6	4.7	5.0	5.4	5.6	5.8	6.0	6.3	6.5	6.8	7.1	7.4	7.6	3.7	4.5	5.3	6.0	6.9	7.7	8.6	4
5	5.1	5.3	5.6	6.0	6.2	6.4	6.7	6.9	7.1	7.4	7.8	8.1	8.3	4.1	5.0	5.8	6.7	7.5	8.4	9.3	5
6	5.6	5.8	6.1	6.5	6.8	7.0	7.2	7.4	7.7	8.0	8.4	8.7	8.9	4.6	5.5	6.3	7.2	8.1	9.0	10.0	6
7	6.0	6.2	6.5	6.9	7.2	7.5	7.7	7.9	8.2	8.5	8.9	9.3	9.5	5.0	5.9	6.8	7.7	8.7	9.6	10.5	7
8	6.4	6.6	7.0	7.4	7.7	7.9	8.2	8.4	8.7	9.0	9.4	9.8	10.0	5.3	6.3	7.2	8.2	9.1	10.1	11.1	8
9	6.7	7.0	7.3	7.7	8.1	8.3	8.6	8.8	9.1	9.4	9.8	10.2	10.4	5.7	6.6	7.6	8.6	9.6	10.5	11.5	9
10	7.0	7.3	7.6	8.1	8.4	8.7	8.9	9.2	9.4	9.8	10.2	10.6	10.8	5.9	6.9	7.9	8.9	9.9	10.9	11.9	10
11	7.3	7.6	7.9	8.4	8.7	9.0	9.2	9.5	9.8	10.1	10.6	10.9	11.2	6.2	7.2	8.2	9.2	10.3	11.3	12.3	11
12	7.6	7.8	8.2	8.6	9.0	9.3	9.5	9.8	10.1	10.4	10.9	11.2	11.5	6.4	7.4	8.5	9.5	10.6	11.6	12.7	12
13	7.8	8.0	8.4	8.9	9.2	9.5	9.8	10.1	10.3	10.7	11.1	11.5	11.8	6.6	7.6	8.7	9.8	10.8	11.9	13.0	13
14	8.0	8.2	8.6	9.1	9.5	9.8	10.0	10.3	10.6	10.9	11.4	11.8	12.0	6.7	7.8	8.9	10.0	11.1	12.2	13.2	14
15	8.1	8.4	8.8	9.3	9.7	10.0	10.2	10.5	10.8	11.2	11.6	12.0	12.3	6.9	8.0	9.1	10.2	11.3	12.4	13.5	15
16	8.3	8.6	9.0	9.5	9.9	10.2	10.4	10.7	11.0	11.4	11.9	12.3	12.5	7.0	8.2	9.3	10.4	11.5	12.6	13.7	16
17	8.5	8.7	9.2	9.7	10.0	10.3	10.6	10.9	11.2	11.6	12.1	12.5	12.7	7.2	8.3	9.5	10.6	11.8	12.9	14.0	17
18	8.6	8.9	9.3	9.8	10.2	10.5	10.8	11.1	11.4	11.8	12.3	12.7	13.0	7.3	8.5	9.7	10.8	12.0	13.1	14.2	18

TABLE 7—*Continued*

Age Months	Centiles													Standard deviations							Age, Months
	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D	MEDIAN	+1S.D.	+2S.D.	+3S.D.	
19	8.8	9.1	9.5	10.0	10.4	10.7	11.0	11.3	11.6	12.0	12.5	12.9	13.2	7.5	8.6	9.8	11.0	12.2	13.3	14.5	19
20	8.9	9.2	9.7	10.2	10.6	10.9	11.2	11.5	11.8	12.2	12.7	13.1	13.4	7.6	8.8	10.0	11.2	12.4	13.5	14.7	20
21	9.1	9.4	9.8	10.4	10.7	11.1	11.4	11.7	12.0	12.4	12.9	13.3	13.6	7.7	9.0	10.2	11.4	12.6	13.8	15.0	21
22	9.3	9.5	10.0	10.5	10.9	11.2	11.5	11.9	12.2	12.6	13.1	13.6	13.9	7.9	9.1	10.3	11.5	12.8	14.0	15.2	22
23	9.4	9.7	10.2	10.7	11.1	11.4	11.7	12.0	12.4	12.8	13.3	13.8	14.1	8.0	9.3	10.5	11.7	13.0	14.2	15.5	23
24	**9.6**	**9.9**	**10.3**	**10.9**	**11.3**	**11.6**	**11.9**	**12.2**	**12.6**	**13.0**	**13.6**	**14.0**	**14.3**	**8.2**	**9.4**	**10.7**	**11.9**	**13.2**	**14.5**	**15.8**	**24**
25	9.7	10.0	10.5	11.0	11.4	11.8	12.1	12.4	12.8	13.2	13.8	14.2	14.6	8.3	9.6	10.8	12.1	13.4	14.7	16.0	25
26	9.9	10.2	10.6	11.2	11.6	11.9	12.3	12.6	13.0	13.4	14.0	14.5	14.8	8.5	9.7	11.0	12.3	13.6	14.9	16.3	26
27	10.1	10.3	10.8	11.4	11.8	12.1	12.4	12.8	13.1	13.6	14.2	14.7	15.0	8.6	9.9	11.2	12.4	13.8	15.2	16.6	27
28	10.2	10.5	11.0	11.5	11.9	12.3	12.6	13.0	13.3	13.8	14.4	14.9	15.2	8.8	10.1	11.3	12.6	14.0	15.4	16.8	28
29	10.4	10.7	11.1	11.7	12.1	12.4	12.8	13.1	13.5	14.0	14.6	15.1	15.5	8.9	10.2	11.5	12.8	14.2	15.6	17.1	29
30	10.5	10.8	11.3	11.8	12.3	12.6	12.9	13.3	13.7	14.2	14.8	15.3	15.7	9.1	10.3	11.6	12.9	14.4	15.9	17.3	30
31	10.6	11.0	11.4	12.0	12.4	12.8	13.1	13.5	13.9	14.4	15.0	15.6	15.9	9.2	10.5	11.8	13.1	14.6	16.1	17.6	31
32	10.8	11.1	11.6	12.2	12.6	12.9	13.3	13.7	14.1	14.6	15.2	15.8	16.1	9.3	10.6	11.9	13.3	14.8	16.3	17.8	32
33	**10.9**	**11.2**	**11.7**	**12.3**	**12.7**	**13.1**	**13.4**	**13.8**	**14.2**	**14.7**	**15.4**	**16.0**	**16.3**	**9.4**	**10.7**	**12.1**	**13.4**	**15.0**	**16.5**	**18.1**	**33**
34	11.0	11.4	11.9	12.5	12.9	13.3	13.6	14.0	14.4	14.9	15.6	16.2	16.6	9.5	10.9	12.2	13.6	15.2	16.7	18.3	34
35	11.2	11.5	12.0	12.6	13.0	13.4	13.8	14.2	14.6	15.1	15.8	16.4	16.8	9.6	11.0	12.4	13.8	15.4	16.9	18.5	35
36	11.3	11.6	12.1	12.7	13.2	13.6	13.9	14.3	14.8	15.3	16.0	16.6	17.0	9.7	11.1	12.5	13.9	15.5	17.1	18.8	36

TABLE 8

Weight (kg) by Age of Girls aged 2–18 years

Age		Centiles												Standard deviations							Age	
Yrs	Mths	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	Yrs	Mths
2	0	9.6	9.9	10.3	10.8	11.2	11.5	11.8	12.2	12.5	13.0	13.6	14.1	14.4	8.3	9.4	10.6	11.8	13.2	14.6	16.0	2	0
2	1	9.7	10.0	10.5	11.0	11.4	11.7	12.0	12.4	12.8	13.2	13.9	14.4	14.8	8.4	9.6	10.8	12.0	13.5	14.9	16.4	2	1
2	2	9.9	10.2	10.6	11.2	11.6	11.9	12.2	12.6	13.0	13.5	14.2	14.7	15.1	8.5	9.8	11.0	12.2	13.7	15.2	16.8	2	2
2	3	10.1	10.4	10.8	11.4	11.8	12.1	12.4	12.8	13.3	13.7	14.4	15.0	15.4	8.6	9.9	11.2	12.4	14.0	15.6	17.1	2	3
2	4	10.2	10.5	11.0	11.6	12.0	12.3	12.6	13.0	13.5	14.0	14.7	15.3	15.7	8.8	10.1	11.3	12.6	14.2	15.9	17.5	2	4
2	5	10.4	10.7	11.1	11.7	12.1	12.5	12.8	13.3	13.7	14.2	15.0	15.6	16.0	8.9	10.2	11.5	12.8	14.5	16.1	17.8	2	5
2	6	10.5	10.8	11.3	11.9	12.3	12.7	13.0	13.5	13.9	14.5	15.2	15.8	16.2	9.0	10.3	11.7	13.0	14.7	16.4	18.1	2	6
2	7	10.6	11.0	11.5	12.1	12.5	12.9	13.2	13.7	14.1	14.7	15.5	16.1	16.5	9.1	10.5	11.9	13.2	15.0	16.7	18.5	2	7
2	8	10.8	11.1	11.6	12.2	12.7	13.0	13.4	13.9	14.3	14.9	15.7	16.3	16.8	9.2	10.6	12.0	13.4	15.2	17.0	18.8	2	8
2	9	10.9	11.3	11.8	12.4	12.8	13.2	13.6	14.0	14.5	15.1	15.9	16.6	17.0	9.4	10.8	12.2	13.6	15.4	17.2	19.1	2	9
2	10	11.1	11.4	11.9	12.6	13.0	13.4	13.8	14.2	14.7	15.3	16.2	16.8	17.3	9.5	10.9	12.3	13.8	15.6	17.5	19.4	2	10
2	11	11.2	11.5	12.1	12.7	13.2	13.6	13.9	14.4	14.9	15.5	16.4	17.1	17.5	9.6	11.0	12.5	13.9	15.8	17.8	19.7	2	11
3	0	11.3	11.7	12.2	12.9	13.3	13.7	14.1	14.6	15.1	15.7	16.6	17.3	17.8	9.7	11.2	12.6	14.1	16.1	18.0	20.0	3	0
3	1	11.5	11.8	12.4	13.0	13.5	13.9	14.3	14.8	15.3	15.9	16.8	17.5	18.0	9.8	11.3	12.8	14.3	16.3	18.3	20.2	3	1
3	2	11.6	11.9	12.5	13.2	13.6	14.1	14.4	15.0	15.5	16.1	17.0	17.8	18.3	9.9	11.4	12.9	14.4	16.5	18.5	20.5	3	2
3	3	11.7	12.1	12.6	13.3	13.8	14.2	14.6	15.1	15.7	16.3	17.2	18.0	18.5	10.0	11.5	13.1	14.6	16.7	18.7	20.8	3	3
3	4	11.8	12.2	12.8	13.4	13.9	14.4	14.8	15.3	15.9	16.5	17.4	18.2	18.7	10.1	11.6	13.2	14.8	16.9	19.0	21.1	3	4
3	5	12.0	12.3	12.9	13.6	14.1	14.5	14.9	15.5	16.0	16.7	17.6	18.4	18.9	10.2	11.8	13.3	14.9	17.0	19.2	21.3	3	5
3	6	12.1	12.5	13.0	13.7	14.2	14.7	15.1	15.6	16.2	16.9	17.8	18.6	19.1	10.3	11.9	13.5	15.1	17.2	19.4	21.6	3	6
3	7	12.2	12.6	13.2	13.9	14.4	14.8	15.2	15.8	16.4	17.1	18.0	18.8	19.4	10.4	12.0	13.6	15.2	17.4	19.6	21.8	3	7
3	8	12.3	12.7	13.3	14.0	14.5	15.0	15.4	15.9	16.5	17.3	18.2	19.0	19.6	10.5	12.1	13.7	15.4	17.6	19.8	22.1	3	8
3	9	12.4	12.8	13.4	14.1	14.7	15.1	15.5	16.1	16.7	17.4	18.4	19.3	19.8	10.6	12.2	13.9	15.5	17.8	20.1	22.3	3	9
3	10	12.5	12.9	13.5	14.3	14.8	15.2	15.7	16.3	16.9	17.6	18.6	19.5	20.0	10.7	12.3	14.0	15.7	18.0	20.3	22.6	3	10
3	11	12.6	13.0	13.7	14.4	14.9	15.4	15.8	16.4	17.0	17.8	18.8	19.7	20.2	10.8	12.4	14.1	15.8	18.1	20.5	22.8	3	11

TABLE 8—*Continued*

Age		Centiles												Standard deviations							Age	
Yrs	Mths	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	Yrs	Mths
4	0	12.8	13.2	13.8	14.5	15.1	15.5	16.0	16.6	17.2	18.0	19.0	19.9	20.4	10.9	12.6	14.3	16.0	18.3	20.7	23.1	4	0
4	1	12.9	13.3	13.9	14.7	15.2	15.7	16.1	16.7	17.4	18.1	19.2	20.0	20.6	10.9	12.7	14.4	16.1	18.5	20.9	23.3	4	1
4	2	13.0	13.4	14.0	14.8	15.3	15.8	16.2	16.9	17.5	18.3	19.4	20.2	20.8	11.0	12.8	14.5	16.2	18.7	21.1	23.5	4	2
4	3	13.1	13.5	14.1	14.9	15.5	15.9	16.4	17.0	17.7	18.5	19.5	20.4	21.0	11.1	12.9	14.6	16.4	18.9	21.3	23.8	4	3
4	4	13.2	13.6	14.3	15.0	15.6	16.1	16.5	17.2	17.8	18.6	19.7	20.6	21.2	11.2	13.0	14.8	16.5	19.0	21.5	24.0	4	4
4	5	13.3	13.7	14.4	15.2	15.7	16.2	16.7	17.3	18.0	18.8	19.9	20.8	21.4	11.3	13.1	14.9	16.7	19.2	21.7	24.3	4	5
4	6	13.4	13.8	14.5	15.3	15.9	16.4	16.8	17.5	18.2	19.0	20.1	21.0	21.6	11.4	13.2	15.0	16.8	19.4	21.9	24.5	4	6
4	7	13.5	13.9	14.6	15.4	16.0	16.5	17.0	17.6	18.3	19.1	20.3	21.2	21.8	11.5	13.3	15.1	17.0	19.6	22.2	24.8	4	7
4	8	13.6	14.1	14.7	15.5	16.1	16.6	17.1	17.8	18.5	19.3	20.5	21.4	22.1	11.5	13.4	15.2	17.1	19.7	22.4	25.0	4	8
4	9	13.7	14.2	14.8	15.7	16.3	16.8	17.2	17.9	18.6	19.5	20.7	21.6	22.3	11.6	13.5	15.4	17.2	19.9	22.6	25.3	4	9
4	10	13.8	14.3	15.0	15.8	16.4	16.9	17.4	18.1	18.8	19.7	20.8	21.8	22.5	11.7	13.6	15.5	17.4	20.1	22.8	25.5	4	10
4	11	13.9	14.4	15.1	15.9	16.5	17.0	17.5	18.2	19.0	19.8	21.0	22.0	22.7	11.8	13.7	15.6	17.5	20.3	23.0	25.8	4	11
5	0	14.0	14.5	15.2	16.0	16.7	17.2	17.7	18.4	19.1	20.0	21.2	22.2	22.9	11.9	13.8	15.7	17.7	20.4	23.2	26.0	5	0
5	1	14.1	14.6	15.3	16.2	16.8	17.3	17.8	18.5	19.3	20.2	21.4	22.5	23.1	11.9	13.9	15.9	17.8	20.6	23.5	26.3	5	1
5	2	14.2	14.7	15.4	16.3	16.9	17.5	18.0	18.7	19.5	20.4	21.6	22.7	23.3	12.0	14.0	16.0	18.0	20.8	23.7	26.5	5	2
5	3	14.3	14.8	15.5	16.4	17.1	17.6	18.1	18.8	19.6	20.5	21.8	22.9	23.6	12.1	14.1	16.1	18.1	21.0	23.9	26.8	5	3
5	4	14.4	14.9	15.7	16.5	17.2	17.7	18.3	19.0	19.8	20.7	22.0	23.1	23.8	12.2	14.2	16.2	18.3	21.2	24.1	27.1	5	4
5	5	14.5	15.0	15.8	16.7	17.3	17.9	18.4	19.2	20.0	20.9	22.2	23.3	24.0	12.2	14.3	16.4	18.4	21.4	24.4	27.4	5	5
5	6	14.6	15.1	15.9	16.8	17.5	18.0	18.6	19.3	20.1	21.1	22.4	23.6	24.3	12.3	14.4	16.5	18.6	21.6	24.6	27.7	5	6
5	7	14.7	15.2	16.0	16.9	17.6	18.2	18.7	19.5	20.3	21.3	22.7	23.8	24.5	12.4	14.5	16.6	18.7	21.8	24.9	28.0	5	7
5	8	14.9	15.4	16.1	17.1	17.7	18.3	18.9	19.7	20.5	21.5	22.9	24.0	24.8	12.5	14.6	16.7	18.9	22.0	25.1	28.3	5	8
5	9	15.0	15.5	16.3	17.2	17.9	18.5	19.0	19.8	20.7	21.7	23.1	24.3	25.0	12.5	14.7	16.9	19.0	22.2	25.4	28.6	5	9
5	10	15.1	15.6	16.4	17.3	18.0	18.6	19.2	20.0	20.9	21.9	23.3	24.5	25.3	12.6	14.8	17.0	19.2	22.4	25.7	28.9	5	10
5	11	15.2	15.7	16.5	17.5	18.2	18.8	19.4	20.2	21.1	22.1	23.6	24.8	25.5	12.7	14.9	17.1	19.4	22.6	25.9	29.2	5	11

TABLE 8—*Continued*

Age		Centiles												Standard deviations							Age	
Yrs	*Mths*	*3rd*	*5th*	*10th*	*20th*	*30th*	*40th*	*50th*	*60th*	*70th*	*80th*	*90th*	*95th*	*97th*	*−3S.D.*	*−2S.D.*	*−1S.D.*	*MEDIAN*	*+1S.D.*	*+2S.D.*	*+3S.D.*	*Yrs*	*Mths*
6	0	15.3	15.8	16.6	17.6	18.3	19.0	19.5	20.4	21.3	22.3	23.8	25.0	25.8	12.8	15.0	17.3	19.5	22.9	26.2	29.6	6	0
6	1	15.4	15.9	16.8	17.8	18.5	19.1	19.7	20.6	21.5	22.6	24.1	25.3	26.1	12.8	15.1	17.4	19.7	23.1	26.5	29.9	6	1
6	2	15.5	16.0	16.9	17.9	18.7	19.3	19.9	20.7	21.7	22.8	24.3	25.6	26.4	12.9	15.2	17.5	19.9	23.3	26.8	30.2	6	2
6	3	15.6	16.2	17.0	18.1	18.8	19.5	20.0	20.9	21.9	23.0	24.6	25.8	26.7	13.0	15.3	17.7	20.0	23.6	27.1	30.6	6	3
6	4	15.7	16.3	17.2	18.2	19.0	19.6	20.2	21.1	22.1	23.2	24.8	26.1	27.0	13.0	15.4	17.8	20.2	23.8	27.4	31.0	6	4
6	5	15.8	16.4	17.3	18.4	19.1	19.8	20.4	21.3	22.3	23.5	25.1	26.4	27.3	13.1	15.5	18.0	20.4	24.1	27.7	31.4	6	5
6	6	15.9	16.5	17.4	18.5	19.3	20.0	20.6	21.5	22.6	23.7	25.4	26.7	27.6	13.2	15.7	18.1	20.6	24.3	28.0	31.8	6	6
6	7	16.1	16.7	17.6	18.7	19.5	20.2	20.8	21.8	22.8	24.0	25.7	27.0	27.9	13.2	15.8	18.3	20.8	24.6	28.4	32.2	6	7
6	8	16.2	16.8	17.7	18.8	19.7	20.3	21.0	22.0	23.0	24.2	25.9	27.3	28.3	13.3	15.9	18.4	21.0	24.9	28.7	32.6	6	8
6	9	16.3	16.9	17.9	19.0	19.8	20.5	21.2	22.2	23.3	24.5	26.2	27.7	28.6	13.4	16.0	18.6	21.2	25.1	29.1	33.0	6	9
6	10	16.4	17.0	18.0	19.2	20.0	20.7	21.4	22.4	23.5	24.8	26.6	28.0	29.0	13.4	16.1	18.8	21.4	25.4	29.4	33.5	6	10
6	11	16.5	17.2	18.2	19.3	20.2	20.9	21.6	22.7	23.8	25.1	26.9	28.4	29.3	13.5	16.2	18.9	21.6	25.7	29.8	33.9	6	11
7	0	16.7	17.3	18.3	19.5	20.4	21.1	21.8	22.9	24.0	25.4	27.2	28.7	29.7	13.6	16.3	19.1	21.8	26.0	30.2	34.4	7	0
7	1	16.8	17.4	18.5	19.7	20.6	21.4	22.1	23.1	24.3	25.7	27.5	29.1	30.1	13.6	16.5	19.3	22.1	26.3	30.6	34.9	7	1
7	2	16.9	17.6	18.6	19.9	20.8	21.6	22.3	23.4	24.6	26.0	27.9	29.5	30.5	13.7	16.6	19.4	22.3	26.6	31.0	35.4	7	2
7	3	17.0	17.7	18.8	20.1	21.0	21.8	22.5	23.7	24.9	26.3	28.2	29.8	30.9	13.8	16.7	19.6	22.5	27.0	31.4	35.9	7	3
7	4	17.2	17.9	19.0	20.3	21.2	22.0	22.8	23.9	25.1	26.6	28.6	30.2	31.3	13.9	16.8	19.8	22.8	27.3	31.8	36.4	7	4
7	5	17.3	18.0	19.1	20.5	21.4	22.2	23.0	24.2	25.4	26.9	28.9	30.6	31.7	13.9	16.9	20.0	23.0	27.6	32.3	36.9	7	5
7	6	17.4	18.2	19.3	20.7	21.6	22.5	23.3	24.5	25.7	27.2	29.3	31.0	32.2	14.0	17.1	20.2	23.3	28.0	32.7	37.5	7	6
7	7	17.6	18.3	19.5	20.9	21.9	22.7	23.5	24.7	26.0	27.6	29.7	31.5	32.6	14.1	17.2	20.4	23.5	28.3	33.2	38.0	7	7
7	8	17.7	18.5	19.6	21.1	22.1	23.0	23.8	25.0	26.4	27.9	30.1	31.9	33.1	14.1	17.3	20.6	23.8	28.7	33.6	38.6	7	8
7	9	17.9	18.6	19.8	21.3	22.3	23.2	24.0	25.3	26.7	28.3	30.5	32.3	33.5	14.2	17.5	20.8	24.0	29.1	34.1	39.2	7	9
7	10	18.0	18.8	20.0	21.5	22.5	23.4	24.3	25.6	27.0	28.6	30.9	32.8	34.0	14.3	17.6	21.0	24.3	29.5	34.6	39.8	7	10
7	11	18.2	19.0	20.2	21.7	22.8	23.7	24.6	25.9	27.3	29.0	31.3	33.2	34.5	14.3	17.7	21.2	24.6	29.8	35.1	40.4	7	11

TABLE 8—*Continued*

Age		Centiles												Standard deviations							Age	
Yrs	*Mths*	*3rd*	*5th*	*10th*	*20th*	*30th*	*40th*	*50th*	*60th*	*70th*	*80th*	*90th*	*95th*	*97th*	*−3S.D.*	*−2S.D.*	*−1S.D.*	*MEDIAN*	*+1S.D.*	*+2S.D.*	*+3S.D.*	*Yrs*	*Mths*
8	0	18.3	19.1	20.4	21.9	23.0	24.0	24.8	26.2	27.7	29.4	31.7	33.7	35.0	14.4	17.9	21.4	24.8	30.2	35.6	41.0	8	0
8	1	18.4	19.3	20.6	22.1	23.3	24.2	25.1	26.5	28.0	29.7	32.2	34.2	35.4	14.5	18.0	21.6	25.1	30.6	36.1	41.6	8	1
8	2	18.6	19.5	20.8	22.4	23.5	24.5	25.4	26.8	28.3	30.1	32.6	34.6	35.9	14.6	18.2	21.8	25.4	31.0	36.6	42.2	8	2
8	3	18.8	19.6	21.0	22.6	23.8	24.8	25.7	27.1	28.7	30.5	33.0	35.1	36.5	14.6	18.3	22.0	25.7	31.4	37.1	42.9	8	3
8	4	18.9	19.8	21.2	22.8	24.0	25.0	26.0	27.5	29.0	30.9	33.5	35.6	37.0	14.7	18.5	22.2	26.0	31.8	37.7	43.5	8	4
8	5	19.1	20.0	21.4	23.1	24.3	25.3	26.3	27.8	29.4	31.3	33.9	36.1	37.5	14.8	18.6	22.5	26.3	32.2	38.2	44.1	8	5
8	6	19.2	20.2	21.6	23.3	24.5	25.6	26.6	28.1	29.8	31.7	34.4	36.6	38.0	14.9	18.8	22.7	26.6	32.7	38.7	44.8	8	6
8	7	19.4	20.3	21.8	23.5	24.8	25.9	26.9	28.5	30.1	32.1	34.8	37.1	38.5	14.9	18.9	22.9	26.9	33.1	39.3	45.5	8	7
8	8	19.6	20.5	22.0	23.8	25.1	26.2	27.2	28.8	30.5	32.5	35.3	37.6	39.1	15.0	19.1	23.1	27.2	33.5	39.8	46.1	8	8
8	9	19.7	20.7	22.2	24.0	25.3	26.5	27.5	29.1	30.9	32.9	35.8	38.1	39.6	15.1	19.2	23.4	27.5	33.9	40.4	46.8	8	9
8	10	19.9	20.9	22.4	24.3	25.6	26.8	27.8	29.5	31.3	33.3	36.2	38.6	40.2	15.2	19.4	23.6	27.8	34.4	41.0	47.5	8	10
8	11	20.1	21.1	22.6	24.5	25.9	27.1	28.1	29.8	31.6	33.8	36.7	39.1	40.7	15.3	19.6	23.9	28.1	34.8	41.5	48.2	8	11
9	0	20.2	21.3	22.9	24.8	26.2	27.4	28.5	30.2	32.0	34.2	37.2	39.7	41.3	15.4	19.7	24.1	28.5	35.3	42.1	48.9	9	0
9	1	20.4	21.5	23.1	25.0	26.5	27.7	28.8	30.5	32.4	34.6	37.7	40.2	41.8	15.5	19.9	24.3	28.8	35.7	42.7	49.6	9	1
9	2	20.6	21.7	23.3	25.3	26.7	28.0	29.1	30.9	32.8	35.1	38.2	40.7	42.4	15.5	20.1	24.6	29.1	36.2	43.2	50.3	9	2
9	3	20.8	21.9	23.5	25.6	27.0	28.3	29.4	31.3	33.2	35.5	38.7	41.3	43.0	15.6	20.2	24.8	29.4	36.6	43.8	51.0	9	3
9	4	21.0	22.1	23.8	25.8	27.3	28.6	29.8	31.6	33.6	35.9	39.2	41.8	43.5	15.7	20.4	25.1	29.8	37.1	44.4	51.7	9	4
9	5	21.2	22.3	24.0	26.1	27.6	28.9	30.1	32.0	34.0	36.4	39.7	42.4	44.1	15.8	20.6	25.4	30.1	37.6	45.0	52.5	9	5
9	6	21.3	22.5	24.3	26.4	27.9	29.2	30.5	32.4	34.4	36.8	40.2	42.9	44.7	15.9	20.8	25.6	30.5	38.0	45.6	53.2	9	6
9	7	21.5	22.7	24.5	26.7	28.2	29.6	30.8	32.7	34.8	37.3	40.7	43.5	45.3	16.0	21.0	25.9	30.8	38.5	46.2	53.9	9	7
9	8	21.7	22.9	24.7	26.9	28.5	29.9	31.1	33.1	35.2	37.7	41.2	44.0	45.9	16.1	21.1	26.1	31.1	39.0	46.8	54.6	9	8
9	9	21.9	23.1	25.0	27.2	28.8	30.2	31.5	33.5	35.7	38.2	41.7	44.6	46.5	16.2	21.3	26.4	31.5	39.4	47.4	55.3	9	9
9	10	22.1	23.4	25.2	27.5	29.1	30.5	31.8	33.9	36.1	38.6	42.2	45.1	47.0	16.4	21.5	26.7	31.8	39.9	48.0	56.1	9	10
9	11	22.3	23.6	25.5	27.8	29.4	30.9	32.2	34.3	36.5	39.1	42.7	45.7	47.6	16.5	21.7	27.0	32.2	40.4	48.6	56.8	9	11

TABLE 8—*Continued*

Age		Centiles												Standard deviations							Age	
Yrs	*Mths*	*3rd*	*5th*	*10th*	*20th*	*30th*	*40th*	*50th*	*60th*	*70th*	*80th*	*90th*	*95th*	*97th*	*−3S.D.*	*−2S.D.*	*−1S.D.*	*MEDIAN*	*+1S.D.*	*+2S.D.*	*+3S.D.*	*Yrs*	*Mths*
10	0	22.5	23.8	25.7	28.1	29.8	31.2	32.5	34.7	36.9	39.6	43.2	46.2	48.2	16.6	21.9	27.2	32.5	40.9	49.2	57.5	10	0
10	1	22.7	24.0	26.0	28.4	30.1	31.5	32.9	35.0	37.3	40.0	43.7	46.8	48.8	16.7	22.1	27.5	32.9	41.4	49.8	58.3	10	1
10	2	23.0	24.2	26.2	28.7	30.4	31.9	33.3	35.4	37.8	40.5	44.3	47.4	49.4	16.8	22.3	27.8	33.3	41.8	50.4	59.0	10	2
10	3	23.2	24.5	26.5	28.9	30.7	32.2	33.6	35.8	38.2	40.9	44.8	47.9	50.0	16.9	22.5	28.1	33.6	42.3	51.0	59.7	10	3
10	4	23.4	24.7	26.8	29.2	31.0	32.6	34.0	36.2	38.6	41.4	45.3	48.5	50.6	17.1	22.7	28.3	34.0	42.8	51.6	60.4	10	4
10	5	23.6	25.0	27.0	29.5	31.4	32.9	34.4	36.6	39.0	41.9	45.8	49.1	51.2	17.2	22.9	28.6	34.4	43.3	52.2	61.2	10	5
10	6	23.8	25.2	27.3	29.8	31.7	33.3	34.7	37.0	39.5	42.3	46.3	49.6	51.8	17.3	23.1	28.9	34.7	43.8	52.8	61.9	10	6
10	7	24.0	25.4	27.6	30.1	32.0	33.6	35.1	37.4	39.9	42.8	46.9	50.2	52.4	17.5	23.3	29.2	35.1	44.3	53.4	62.6	10	7
10	8	24.3	25.7	27.8	30.5	32.3	34.0	35.5	37.8	40.3	43.3	47.4	50.7	52.9	17.6	23.6	29.5	35.5	44.8	54.0	63.3	10	8
10	9	24.5	25.9	28.1	30.8	32.7	34.3	35.8	38.2	40.8	43.8	47.9	51.3	53.5	17.8	23.8	29.8	35.8	45.2	54.6	64.1	10	9
10	10	24.7	26.2	28.4	31.1	33.0	34.7	36.2	38.6	41.2	44.2	48.4	51.9	54.1	17.9	24.0	30.1	36.2	45.7	55.2	64.8	10	10
10	11	25.0	26.4	28.7	31.4	33.3	35.0	36.6	39.0	41.6	44.7	48.9	52.4	54.7	18.1	24.2	30.4	36.6	46.2	55.8	65.5	10	11
11	0	25.2	26.7	28.9	31.7	33.7	35.4	37.0	39.4	42.1	45.2	49.4	53.0	55.3	18.2	24.5	30.7	37.0	46.7	56.4	66.2	11	0
11	1	25.4	26.9	29.2	32.0	34.0	35.7	37.3	39.8	42.5	45.6	50.0	53.5	55.9	18.4	24.7	31.0	37.3	47.2	57.0	66.9	11	1
11	2	25.7	27.2	29.5	32.3	34.4	36.1	37.7	40.2	42.9	46.1	50.5	54.1	56.4	18.5	24.9	31.3	37.7	47.7	57.6	67.6	11	2
11	3	25.9	27.5	29.8	32.6	34.7	36.4	38.1	40.6	43.4	46.6	51.0	54.6	57.0	18.7	25.2	31.6	38.1	48.2	58.2	68.3	11	3
11	4	26.2	27.7	30.1	33.0	35.0	36.8	38.5	41.0	43.8	47.0	51.5	55.2	57.6	18.9	25.4	31.9	38.5	48.6	58.8	69.0	11	4
11	5	26.4	28.0	30.4	33.3	35.4	37.2	38.8	41.4	44.2	47.5	52.0	55.7	58.2	19.0	25.6	32.2	38.8	49.1	59.4	69.7	11	5
11	6	26.7	28.3	30.7	33.6	35.7	37.5	39.2	41.9	44.7	48.0	52.5	56.3	58.7	19.2	25.9	32.6	39.2	49.6	60.0	70.3	11	6
11	7	26.9	28.5	31.0	33.9	36.1	37.9	39.6	42.3	45.1	48.4	53.0	56.8	59.3	19.4	26.1	32.9	39.6	50.1	60.5	71.0	11	7
11	8	27.2	28.8	31.3	34.3	36.4	38.3	40.0	42.7	45.5	48.9	53.5	57.4	59.9	19.6	26.4	33.2	40.0	50.5	61.1	71.7	11	8
11	9	27.5	29.1	31.6	34.6	36.8	38.6	40.4	43.1	46.0	49.3	54.0	57.9	60.4	19.8	26.6	33.5	40.4	51.0	61.7	72.3	11	9
11	10	27.7	29.4	31.9	34.9	37 1	39.0	40.8	43.5	46.4	49.8	54.5	58.4	61.0	20.0	26.9	33.8	40.8	51.5	62.2	73.0	11	10
11	11	28.0	29.6	32.2	35.3	37.5	39.4	41.1	43.9	46.8	50.3	55.0	58.9	61.5	20.2	27.2	34.2	41.1	52.0	62.8	73.6	11	11

TABLE 8—*Continued*

Age		Centiles													Standard deviations							Age	
Yrs	Mths	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	Yrs	Mths
12	0	28.3	29.9	32.5	35.6	37.8	39.7	41.5	44.3	47.2	50.7	55.5	59.5	62.0	20.4	27.4	34.5	41.5	52.4	63.3	74.2	12	0
12	1	28.5	30.2	32.8	35.9	38.2	40.1	41.9	44.7	47.7	51.2	56.0	60.0	62.6	20.6	27.7	34.8	41.9	52.9	63.9	74.8	12	1
12	2	28.8	30.5	33.1	36.3	38.5	40.5	42.3	45.1	48.1	51.6	56.5	60.5	63.1	20.8	28.0	35.1	42.3	53.4	64.4	75.5	12	2
12	3	29.1	30.8	33.4	36.6	38.9	40.9	42.7	45.5	48.5	52.1	56.9	61.0	63.6	21.0	28.2	35.5	42.7	53.8	64.9	76.1	12	3
12	4	29.4	31.1	33.7	36.9	39.3	41.2	43.1	45.9	48.9	52.5	57.4	61.5	64.1	21.2	28.5	35.8	43.1	54.3	65.5	76.7	12	4
12	5	29.7	31.4	34.1	37.3	39.6	41.6	43.5	46.3	49.4	52.9	57.9	62.0	64.6	21.5	28.8	36.1	43.5	54.7	66.0	77.2	12	5
12	6	30.0	31.7	34.4	37.6	40.0	42.0	43.8	46.7	49.8	53.4	58.4	62.5	65.1	21.7	29.1	36.5	43.8	55.2	66.5	77.8	12	6
12	7	30.2	32.0	34.7	38.0	40.3	42.3	44.2	47.1	50.2	53.8	58.8	63.0	65.6	21.9	29.4	36.8	44.2	55.6	67.0	78.4	12	7
12	8	30.5	32.3	35.0	38.3	40.7	42.7	44.6	47.5	50.6	54.2	59.3	63.4	66.1	22.2	29.6	37.1	44.6	56.0	67.5	78.9	12	8
12	9	30.8	32.6	35.3	38.6	41.0	43.1	45.0	47.9	51.0	54.7	59.7	63.9	66.6	22.4	29.9	37.5	45.0	56.5	68.0	79.5	12	9
12	10	31.1	32.9	35.7	39.0	41.4	43.4	45.4	48.3	51.4	55.1	60.2	64.4	67.1	22.7	30.2	37.8	45.4	56.9	68.5	80.0	12	10
12	11	31.4	33.2	36.0	39.3	41.7	43.8	45.7	48.7	51.8	55.5	60.6	64.8	67.6	22.9	30.5	38.1	45.7	57.3	68.9	80.6	12	11
13	0	31.7	33.5	36.3	39.7	42.1	44.2	46.1	49.0	52.2	55.9	61.0	65.3	68.0	23.1	30.8	38.4	46.1	57.8	69.4	81.1	13	0
13	1	32.0	33.8	36.6	40.0	42.4	44.5	46.5	49.4	52.6	56.3	61.5	65.7	68.5	23.4	31.1	38.8	46.5	58.2	69.9	81.6	13	1
13	2	32.3	34.1	36.9	40.3	42.8	44.9	46.8	49.8	53.0	56.7	61.9	66.2	68.9	23.6	31.4	39.1	46.8	58.6	70.3	82.1	13	2
13	3	32.6	34.4	37.2	40.7	43.1	45.2	47.2	50.2	53.4	57.1	62.3	66.6	69.4	23.9	31.7	39.4	47.2	59.0	70.8	82.6	13	3
13	4	32.9	34.7	37.6	41.0	43.5	45.6	47.6	50.6	53.8	57.5	62.7	67.0	69.8	24.2	32.0	39.8	47.6	59.4	71.2	83.1	13	4
13	5	33.2	35.0	37.9	41.3	43.8	45.9	47.9	50.9	54.1	57.9	63.1	67.4	70.3	24.4	32.2	40.1	47.9	59.8	71.7	83.5	13	5
13	6	33.5	35.3	38.2	41.6	44.1	46.3	48.3	51.3	54.5	58.3	63.5	67.9	70.7	24.7	32.5	40.4	48.3	60.2	72.1	84.0	13	6
13	7	33.8	35.6	38.5	42.0	44.5	46.6	48.6	51.6	54.9	58.7	63.9	68.3	71.1	24.9	32.8	40.7	48.6	60.6	72.5	84.4	13	7
13	8	34.0	35.9	38.8	42.3	44.8	46.9	49.0	52.0	55.2	59.0	64.3	68.7	71.5	25.2	33.1	41.0	49.0	60.9	72.9	84.9	13	8
13	9	34.3	36.2	39.1	42.6	45.1	47.3	49.3	52.3	55.6	59.4	64.7	69.0	71.9	25.4	33.4	41.3	49.3	61.3	73.3	85.3	13	9
13	10	34.6	36.5	39.4	42.9	45.4	47.6	49.6	52.7	55.9	59.8	65.1	69.4	72.3	25.7	33.7	41.7	49.6	61.7	73.7	85.7	13	10
13	11	34.9	36.8	39.7	43.2	45.8	47.9	50.0	53.0	56.3	60.1	65.4	69.8	72.7	26.0	34.0	42.0	50.0	62.0	74.1	86.2	13	11

TABLE 8—*Continued*

Age		Centiles												Standard deviations							Age	
Yrs	*Mths*	*3rd*	*5th*	*10th*	*20th*	*30th*	*40th*	*50th*	*60th*	*70th*	*80th*	*90th*	*95th*	*97th*	*−3S.D.*	*−2S.D.*	*−1S.D.*	*MEDIAN*	*+1S.D.*	*+2S.D.*	*+3S.D.*	*Yrs*	*Mths*
14	0	35.2	37.1	40.0	43.5	46.1	48.2	50.3	53.3	56.6	60.5	65.8	70.2	73.0	26.2	34.2	42.3	50.3	62.4	74.5	86.6	14	0
14	1	35.5	37.4	40.3	43.8	46.4	48.6	50.6	53.7	57.0	60.8	66.1	70.5	73.4	26.5	34.5	42.6	50.6	62.7	74.8	86.9	14	1
14	2	35.8	37.7	40.6	44.1	46.7	48.9	50.9	54.0	57.3	61.1	66.5	70.9	73.7	26.7	34.8	42.9	50.9	63.0	75.2	87.3	14	2
14	3	36.0	37.9	40.9	44.4	47.0	49.2	51.2	54.3	57.6	61.5	66.8	71.2	74.1	27.0	35.1	43.1	51.2	63.4	75.5	87.7	14	3
14	4	36.3	38.2	41.2	44.7	47.3	49.5	51.5	54.6	57.9	61.8	67.1	71.6	74.4	27.3	35.3	43.4	51.5	63.7	75.9	88.1	14	4
14	5	36.6	38.5	41.4	45.0	47.6	49.8	51.8	54.9	58.2	62.1	67.4	71.9	74.8	27.5	35.6	43.7	51.8	64.0	76.2	88.4	14	5
14	6	36.8	38.8	41.7	45.3	47.8	50.0	52.1	55.2	58.5	62.4	67.8	72.2	75.1	27.8	35.9	44.0	52.1	64.3	76.5	88.7	14	6
14	7	37.1	39.0	42.0	45.5	48.1	50.3	52.4	55.5	58.8	62.7	68.1	72.5	75.4	28.0	36.1	44.3	52.4	64.6	76.8	89.1	14	7
14	8	37.4	39.3	42.2	45.8	48.4	50.6	52.7	55.8	59.1	63.0	68.4	72.8	75.7	28.3	36.4	44.5	52.7	64.9	77.1	89.4	14	8
14	9	37.6	39.5	42.5	46.1	48.7	50.9	52.9	56.0	59.4	63.2	68.6	73.1	76.0	28.5	36.6	44.8	52.9	65.2	77.4	89.7	14	9
14	10	37.9	39.8	42.7	46.3	48.9	51.1	53.2	56.3	59.6	63.5	68.9	73.4	76.3	28.8	36.9	45.0	53.2	65.5	77.7	90.0	14	10
14	11	38.1	40.0	43.0	46.6	49.2	51.4	53.4	56.5	59.9	63.8	69.2	73.6	76.5	29.0	37.1	45.3	53.4	65.7	78.0	90.3	14	11
15	0	38.3	40.3	43.2	46.8	49.4	51.6	53.7	56.8	60.1	64.0	69.4	73.9	76.8	29.2	37.4	45.5	53.7	66.0	78.3	90.6	15	0
15	1	38.6	40.5	43.5	47.1	49.6	51.9	53.9	57.0	60.4	64.3	69.7	74.1	77.1	29.5	37.6	45.8	53.9	66.2	78.5	90.8	15	1
15	2	38.8	40.7	43.7	47.3	49.9	52.1	54.1	57.3	60.6	64.5	69.9	74.4	77.3	29.7	37.9	46.0	54.1	66.4	78.8	91.1	15	2
15	3	39.0	41.0	43.9	47.5	50.1	52.3	54.4	57.5	60.8	64.7	70.1	74.6	77.5	29.9	38.1	46.2	54.4	66.7	79.0	91.3	15	3
15	4	39.3	41.2	44.1	47.7	50.3	52.5	54.6	57.7	61.0	64.9	70.4	74.8	77.8	30.2	38.3	46.4	54.6	66.9	79.2	91.5	15	4
15	5	39.5	41.4	44.4	47.9	50.5	52.7	54.8	57.9	61.2	65.1	70.6	75.1	78.0	30.4	38.5	46.6	54.8	67.1	79.4	91.8	15	5
15	6	39.7	41.6	44.6	48.1	50.7	52.9	55.0	58.1	61.4	65.3	70.8	75.3	78.2	30.6	38.7	46.8	55.0	67.3	79.6	92.0	15	6
15	7	39.9	41.8	44.7	48.3	50.9	53.1	55.1	58.3	61.6	65.5	71.0	75.4	78.4	30.8	38.9	47.0	55.1	67.5	79.8	92.2	15	7
15	8	40.1	42.0	44.9	48.5	51.1	53.3	55.3	58.4	61.8	65.7	71.1	75.6	78.5	31.0	39.1	47.2	55.3	67.7	80.0	92.3	15	8
15	9	40.3	42.2	45.1	48.7	51.2	53.4	55.5	58.6	61.9	65.9	71.3	75.8	78.7	31.2	39.3	47.4	55.5	67.8	80.2	92.5	15	9
15	10	40.5	42.4	45.3	48.8	51.4	53.6	55.6	58.7	62.1	66.0	71.5	75.9	78.9	31.4	39.5	47.6	55.6	68.0	80.3	92.7	15	10
15	11	40.6	42.5	45.4	49.0	51.5	53.7	55.8	58.9	62.2	66.2	71.6	76.1	79.0	31.6	39.7	47.7	55.8	68.1	80.5	92.8	15	11

TABLE 8—*Continued*

Age		Centiles												Standard deviations							Age	
Yrs	Mths	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	Yrs	Mths
16	0	40.8	42.7	45.6	49.1	51.7	53.9	55.9	59.0	62.4	66.3	71.7	76.2	79.1	31.8	39.8	47.9	55.9	68.2	80.6	93.0	16	0
16	1	41.0	42.8	45.8	49.3	51.8	54.0	56.0	59.1	62.5	66.4	71.9	76.3	79.3	32.0	40.0	48.0	56.0	68.4	80.7	93.1	16	1
16	2	41.1	43.0	45.9	49.4	51.9	54.1	56.1	59.2	62.6	66.5	72.0	76.5	79.4	32.2	40.2	48.1	56.1	68.5	80.8	93.2	16	2
16	3	41.2	43.1	46.0	49.5	52.0	54.2	56.2	59.3	62.7	66.6	72.1	76.6	79.5	32.4	40.3	48.3	56.2	68.6	81.0	93.3	16	3
16	4	41.4	43.3	46.1	49.6	52.1	54.3	56.3	59.4	62.8	66.7	72.2	76.7	79.6	32.5	40.4	48.4	56.3	68.7	81.0	93.4	16	4
16	5	41.5	43.4	46.3	49.7	52.2	54.4	56.4	59.5	62.9	66.8	72.2	76.7	79.7	32.7	40.6	48.5	56.4	68.7	81.1	93.5	16	5
16	6	41.6	43.5	46.4	49.8	52.3	54.4	56.4	59.6	62.9	66.9	72.3	76.8	79.7	32.8	40.7	48.6	56.4	68.8	81.2	93.6	16	6
16	7	41.8	43.6	46.5	49.9	52.4	54.5	56.5	59.6	63.0	66.9	72.4	76.9	79.8	33.0	40.8	48.7	56.5	68.9	81.3	93.6	16	7
16	8	41.9	43.7	46.6	50.0	52.5	54.6	56.6	59.7	63.0	67.0	72.4	76.9	79.8	33.1	40.9	48.7	56.6	68.9	81.3	93.7	16	8
16	9	42.0	43.8	46.6	50.1	52.5	54.6	56.6	59.7	63.1	67.0	72.5	77.0	79.9	33.3	41.1	48.8	56.6	69.0	81.4	93.7	16	9
16	10	42.1	43.9	46.7	50.1	52.6	54.7	56.6	59.8	63.1	67.1	72.5	77.0	79.9	33.4	41.2	48.9	56.6	69.0	81.4	93.8	16	10
16	11	42.2	44.0	46.8	50.2	52.6	54.7	56.7	59.8	63.2	67.1	72.5	77.0	80.0	33.6	41.3	49.0	56.7	69.0	81.4	93.8	16	11
17	0	42.3	44.1	46.9	50.2	52.7	54.7	56.7	59.8	63.2	67.1	72.6	77.1	80.0	33.7	41.3	49.0	56.7	69.1	81.5	93.8	17	0
17	1	42.3	44.1	46.9	50.3	52.7	54.8	56.7	59.8	63.2	67.1	72.6	77.1	80.0	33.8	41.4	49.1	56.7	69.1	81.5	93.9	17	1
17	2	42.4	44.2	47.0	50.3	52.7	54.8	56.7	59.9	63.2	67.1	72.6	77.1	80.0	33.9	41.5	49.1	56.7	69.1	81.5	93.9	17	2
17	3	42.5	44.3	47.0	50.4	52.8	54.8	56.7	59.9	63.2	67.1	72.6	77.1	80.0	34.0	41.6	49.2	56.7	69.1	81.5	93.9	17	3
17	4	42.6	44.3	47.1	50.4	52.8	54.8	56.7	59.9	63.2	67.1	72.6	77.1	80.0	34.1	41.7	49.2	56.7	69.1	81.5	93.9	17	4
17	5	42.6	44.4	47.1	50.4	52.8	54.8	56.7	59.9	63.2	67.1	72.6	77.1	80.0	34.2	41.7	49.2	56.7	69.1	81.5	93.9	17	5
17	6	42.7	44.4	47.2	50.4	52.8	54.8	56.7	59.9	63.2	67.1	72.6	77.1	80.0	34.3	41.8	49.3	56.7	69.1	81.5	93.8	17	6
17	7	42.7	44.5	47.2	50.5	52.8	54.8	56.7	59.8	63.2	67.1	72.6	77.1	80.0	34.4	41.9	49.3	56.7	69.1	81.5	93.8	17	7
17	8	42.8	44.5	47.2	50.5	52.8	54.8	56.7	59.8	63.2	67.1	72.5	77.0	80.0	34.5	41.9	49.3	56.7	69.1	81.4	93.8	17	8
17	9	42.8	44.6	47.2	50.5	52.8	54.8	56.7	59.8	63.2	67.1	72.5	77.0	79.9	34.6	42.0	49.3	56.7	69.0	81.4	93.8	17	9
17	10	42.9	44.6	47.3	50.5	52.8	54.8	56.7	59.8	63.1	67.1	72.5	77.0	79.9	34.7	42.0	49.3	56.7	69.0	81.4	93.7	17	10
17	11	42.9	44.6	47.3	50.5	52.8	54.8	56.6	59.8	63.1	67.0	72.5	77.0	79.9	34.8	42.0	49.3	56.6	69.0	81.4	93.7	17	11
18	0	42.9	44.7	47.3	50.5	52.8	54.8	56.6	59.7	63.1	67.0	72.5	76.9	79.9	34.8	42.1	49.4	56.6	69.0	81.3	93.7	18	0

TABLE 9

Weight (kg) by length of Boys 49–103 cm in height

Length cm	Centiles												Standard deviations							Length cm
	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	
49.0	2.5	2.6	2.7	2.9	3.0	3.1	3.1	3.3	3.4	3.6	3.8	4.0	4.1	2.1	2.5	2.8	3.1	3.7	4.2	4.7	49.0
49.5	2.5	2.6	2.8	2.9	3.0	3.1	3.2	3.4	3.5	3.7	3.9	4.1	4.2	2.1	2.5	2.9	3.2	3.7	4.3	4.8	49.5
50.0	2.6	2.7	2.8	3.0	3.1	3.2	3.3	3.4	3.6	3.7	4.0	4.2	4.3	2.2	2.5	2.9	3.3	3.8	4.4	4.9	50.0
50.5	2.6	2.7	2.9	3.1	3.2	3.3	3.4	3.5	3.7	3.8	4.1	4.3	4.4	2.2	2.6	3.0	3.4	3.9	4.5	5.0	50.5
51.0	2.7	2.8	2.9	3.1	3.3	3.4	3.5	3.6	3.8	3.9	4.2	4.4	4.5	2.2	2.6	3.1	3.5	4.0	4.6	5.1	51.0
51.5	2.8	2.9	3.0	3.2	3.3	3.5	3.6	3.7	3.9	4.0	4.3	4.5	4.6	2.3	2.7	3.1	3.6	4.1	4.7	5.2	51.5
52.0	2.8	2.9	3.1	3.3	3.4	3.6	3.7	3.8	4.0	4.1	4.4	4.6	4.7	2.3	2.8	3.2	3.7	4.2	4.8	5.4	52.0
52.5	2.9	3.0	3.2	3.4	3.5	3.7	3.8	3.9	4.1	4.3	4.5	4.7	4.9	2.4	2.8	3.3	3.8	4.3	4.9	5.5	52.5
53.0	3.0	3.1	3.3	3.5	3.6	3.8	3.9	4.0	4.2	4.4	4.6	4.8	5.0	2.4	2.9	3.4	3.9	4.5	5.0	5.6	53.0
53.5	3.0	3.2	3.3	3.6	3.7	3.9	4.0	4.1	4.3	4.5	4.7	5.0	5.1	2.5	3.0	3.5	4.0	4.6	5.2	5.8	53.5
54.0	3.1	3.3	3.4	3.7	3.8	4.0	4.1	4.3	4.4	4.6	4.9	5.1	5.2	2.6	3.1	3.6	4.1	4.7	5.3	5.9	54.0
54.5	3.2	3.3	3.5	3.8	3.9	4.1	4.2	4.4	4.5	4.7	5.0	5.2	5.4	2.6	3.2	3.7	4.2	4.8	5.4	6.0	54.5
55.0	3.3	3.4	3.6	3.9	4.1	4.2	4.3	4.5	4.7	4.9	5.1	5.4	5.5	2.7	3.3	3.8	4.3	5.0	5.6	6.2	55.0
55.5	3.4	3.5	3.7	4.0	4.2	4.3	4.5	4.6	4.8	5.0	5.3	5.5	5.6	2.8	3.3	3.9	4.5	5.1	5.7	6.3	55.5
56.0	3.5	3.7	3.9	4.1	4.3	4.4	4.6	4.7	4.9	5.1	5.4	5.6	5.8	2.9	3.5	4.0	4.6	5.2	5.9	6.5	56.0
56.5	3.6	3.8	4.0	4.2	4.4	4.6	4.7	4.9	5.0	5.3	5.5	5.8	5.9	3.0	3.6	4.1	4.7	5.4	6.0	6.6	56.5
57.0	3.7	3.9	4.1	4.3	4.5	4.7	4.8	5.0	5.2	5.4	5.7	5.9	6.1	3.1	3.7	4.3	4.8	5.5	6.1	6.8	57.0
57.5	3.8	4.0	4.2	4.5	4.7	4.8	5.0	5.1	5.3	5.5	5.8	6.1	6.2	3.2	3.8	4.4	5.0	5.6	6.3	7.0	57.5

TABLE 9—*Continued*

Length cm	Centiles													Standard deviations							Length cm
	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	
58.0	4.0	4.1	4.3	4.6	4.8	5.0	5.1	5.3	5.5	5.7	6.0	6.2	6.4	3.3	3.9	4.5	5.1	5.8	6.4	7.1	58.0
58.5	4.1	4.2	4.4	4.7	4.9	5.1	5.2	5.4	5.6	5.8	6.1	6.4	6.5	3.4	4.0	4.6	5.2	5.9	6.6	7.3	58.5
59.0	4.2	4.3	4.6	4.9	5.0	5.2	5.4	5.6	5.7	6.0	6.3	6.5	6.7	3.5	4.1	4.8	5.4	6.1	6.7	7.4	59.0
59.5	4.3	4.5	4.7	5.0	5.2	5.4	5.5	5.7	5.9	6.1	6.4	6.7	6.8	3.6	4.2	4.9	5.5	6.2	6.9	7.6	59.5
60.0	4.4	4.6	4.8	5.1	5.3	5.5	5.7	5.8	6.0	6.2	6.6	6.8	7.0	3.7	4.4	5.0	5.7	6.4	7.1	7.8	60.0
60.5	4.6	4.7	5.0	5.3	5.5	5.6	5.8	6.0	6.2	6.4	6.7	7.0	7.1	3.8	4.5	5.1	5.8	6.5	7.2	7.9	60.5
61.0	4.7	4.9	5.1	5.4	5.6	5.8	5.9	6.1	6.3	6.5	6.9	7.1	7.3	4.0	4.6	5.3	5.9	6.7	7.4	8.1	61.0
61.5	4.8	5.0	5.2	5.5	5.7	5.9	6.1	6.3	6.5	6.7	7.0	7.3	7.4	4.1	4.8	5.4	6.1	6.8	7.5	8.3	61.5
62.0	5.0	5.1	5.4	5.7	5.9	6.1	6.2	6.4	6.6	6.8	7.2	7.4	7.6	4.2	4.9	5.6	6.2	7.0	7.7	8.4	62.0
62.5	5.1	5.3	5.5	5.8	6.0	6.2	6.4	6.6	6.8	7.0	7.3	7.6	7.8	4.3	5.0	5.7	6.4	7.1	7.8	8.6	62.5
63.0	5.2	5.4	5.6	5.9	6.2	6.4	6.5	6.7	6.9	7.1	7.5	7.7	7.9	4.5	5.2	5.8	6.5	7.3	8.0	8.8	63.0
63.5	5.4	5.5	5.8	6.1	6.3	6.5	6.7	6.9	7.1	7.3	7.6	7.9	8.1	4.6	5.3	6.0	6.7	7.4	8.2	8.9	63.5
64.0	5.5	4.7	5.9	6.2	6.5	6.6	6.8	7.0	7.2	7.5	7.8	8.1	8.2	4.7	5.4	6.1	6.8	7.6	8.3	9.1	64.0
64.5	5.6	5.8	6.1	6.4	6.6	6.8	7.0	7.2	7.4	7.6	7.9	8.2	8.4	4.9	5.6	6.3	7.0	7.7	8.5	9.3	64.5
65.0	5.8	6.0	6.2	6.5	6.7	6.9	7.1	7.3	7.5	7.8	8.1	8.4	8.6	5.0	5.7	6.4	7.1	7.9	8.7	9.4	65.0
65.5	5.9	6.1	6.3	6.7	6.9	7.1	7.3	7.5	7.7	7.9	8.3	8.5	8.7	5.1	5.8	6.5	7.3	8.0	8.8	9.6	65.5
66.0	6.1	6.2	6.5	6.8	7.0	7.2	7.4	7.6	7.8	8.1	8.4	8.7	8.9	5.3	6.0	6.7	7.4	8.2	9.0	9.8	66.0
66.5	6.2	6.4	6.6	6.9	7.2	7.4	7.6	7.8	8.0	8.2	8.6	8.9	9.0	5.4	6.1	6.8	7.6	8.3	9.1	9.9	66.5

TABLE 9—*Continued*

Length cm	Centiles												Standard deviations							Length cm
	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	
67.0	6.3	6.5	6.8	7.1	7.3	7.5	7.7	7.9	8.1	8.4	8.7	9.0	9.2	5.5	6.2	7.0	7.7	8.5	9.3	10.1	67.0
67.5	6.5	6.6	6.9	7.2	7.5	7.7	7.8	8.0	8.3	8.5	8.9	9.2	9.4	5.7	6.4	7.1	7.8	8.6	9.5	10.3	67.5
68.0	6.6	6.8	7.0	7.4	7.6	7.8	8.0	8.2	8.4	8.7	9.0	9.3	9.5	5.8	6.5	7.3	8.0	8.8	9.6	10.4	68.0
68.5	6.7	6.9	7.2	7.5	7.7	7.9	8.1	8.3	8.6	8.8	9.2	9.5	9.7	5.9	6.6	7.4	8.1	8.9	9.8	10.6	68.5
69.0	6.9	7.0	7.3	7.6	7.9	8.1	8.3	8.5	8.7	9.0	9.3	9.6	9.8	6.0	6.8	7.5	8.3	9.1	9.9	10.7	69.0
69.5	7.0	7.2	7.4	7.8	8.0	8.2	8.4	8.6	8.8	9.1	9.5	9.8	10.0	6.2	6.9	7.7	8.4	9.2	10.1	10.9	69.5
70.0	7.1	7.3	7.6	7.9	8.2	8.4	8.5	8.8	9.0	9.3	9.6	9.9	10.1	6.3	7.0	7.8	8.5	9.4	10.2	11.1	70.0
70.5	7.3	7.4	7.7	8.0	8.3	8.5	8.7	8.9	9.1	9.4	9.8	10.1	10.3	6.4	7.2	7.9	8.7	9.5	10.4	11.2	70.5
71.0	7.4	7.6	7.8	8.2	8.4	8.6	8.8	9.0	9.3	9.5	9.9	10.2	10.4	6.5	7.3	8.1	8.8	9.7	10.5	11.4	71.0
71.5	7.5	7.7	8.0	8.3	8.5	8.8	8.9	9.2	9.4	9.7	10.1	10.4	10.6	6.7	7.4	8.2	8.9	9.8	10.7	11.5	71.5
72.0	7.6	7.8	8.1	8.4	8.7	8.9	9.1	9.3	9.5	9.8	10.2	10.5	10.7	6.8	7.5	8.3	9.1	9.9	10.8	11.7	72.0
72.5	7.7	7.9	8.2	8.6	8.8	9.0	9.2	9.4	9.7	9.9	10.3	10.6	10.9	6.9	7.7	8.4	9.2	10.1	11.0	11.8	72.5
73.0	7.9	8.0	8.3	8.7	8.9	9.1	9.3	9.6	9.8	10.1	10.5	10.8	11.0	7.0	7.8	8.6	9.3	10.2	11.1	12.0	73.0
73.5	8.0	8.2	8.5	8.8	9.0	9.3	9.5	9.7	9.9	10.2	10.6	10.9	11.1	7.1	7.9	8.7	9.5	10.3	11.2	12.1	73.5
74.0	8.1	8.3	8.6	8.9	9.2	9.4	9.6	9.8	10.0	10.3	10.7	11.0	11.3	7.2	8.0	8.8	9.6	10.5	11.4	12.3	74.0
74.5	8.2	8.4	8.7	9.0	9.3	9.5	9.7	9.9	10.2	10.5	10.9	11.2	11.4	7.3	8.1	8.9	9.7	10.6	11.5	12.4	74.5
75.0	8.3	8.5	8.8	9.1	9.4	9.6	9.8	10.0	10.3	10.6	11.0	11.3	11.5	7.4	8.2	9.0	9.8	10.7	11.6	12.5	75.0
75.5	8.4	8.6	8.9	9.3	9.5	9.7	9.9	10.2	10.4	10.7	11.1	11.4	11.7	7.5	8.3	9.1	9.9	10.8	11.8	12.7	75.5

TABLE 9—*Continued*

Length cm	Centiles													Standard deviations							Length cm
	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	
76.0	8.5	8.7	9.0	9.4	9.6	9.8	10.0	10.3	10.5	10.8	11.2	11.6	11.8	7.6	8.4	9.2	10.0	11.0	11.9	12.8	76.0
76.5	8.6	8.8	9.1	9.5	9.7	10.0	10.2	10.4	10.6	10.9	11.3	11.7	11.9	7.7	8.5	9.3	10.2	11.1	12.0	12.9	76.5
77.0	8.7	8.9	9.2	9.6	9.8	10.1	10.3	10.5	10.8	11.1	11.5	11.8	12.0	7.8	8.6	9.4	10.3	11.2	12.1	13.1	77.0
77.5	8.8	9.0	9.3	9.7	9.9	10.2	10.4	10.6	10.9	11.2	11.6	11.9	12.2	7.9	8.7	9.5	10.4	11.3	12.3	13.2	77.5
78.0	8.9	9.1	9.4	9.8	10.0	10.3	10.5	10.7	11.0	11.3	11.7	12.0	12.3	8.0	8.8	9.7	10.5	11.4	12.4	13.3	78.0
78.5	9.0	9.2	9.5	9.9	10.2	10.4	10.6	10.8	11.1	11.4	11.8	12.2	12.4	8.1	8.9	9.8	10.6	11.6	12.5	13.5	78.5
79.0	9.1	9.3	9.6	10.0	10.3	10.5	10.7	10.9	11.2	11.5	11.9	12.3	12.5	8.2	9.0	9.9	10.7	11.7	12.6	13.6	79.0
79.5	9.2	9.4	9.7	10.1	10.4	10.6	10.8	11.1	11.3	11.6	12.0	12.4	12.6	8.2	9.1	10.0	10.8	11.8	12.7	13.7	79.5
80.0	9.3	9.5	9.8	10.2	10.5	10.7	10.9	11.2	11.4	11.7	12.2	12.5	12.7	8.3	9.2	10.1	10.9	11.9	12.9	13.8	80.0
80.5	9.4	9.6	9.9	10.3	10.6	10.8	11.0	11.3	11.5	11.8	12.3	12.6	12.9	8.4	9.3	10.1	11.0	12.0	13.0	14.0	80.5
81.0	9.5	9.7	10.0	10.4	10.7	10.9	11.1	11.4	11.6	11.9	12.4	12.7	13.0	8.5	9.4	10.2	11.1	12.1	13.1	14.1	81.0
81.5	9.6	9.8	10.1	10.5	10.8	11.0	11.2	11.5	11.7	12.1	12.5	12.9	13.1	8.6	9.5	10.3	11.2	12.2	13.2	14.2	81.5
82.0	9.7	9.9	10.2	10.6	10.9	11.1	11.3	11.6	11.8	12.2	12.6	13.0	13.2	8.7	9.6	10.4	11.3	12.3	13.3	14.3	82.0
82.5	9.8	10.0	10.3	10.7	11.0	11.2	11.4	11.7	12.0	12.3	12.7	13.1	13.3	8.8	9.6	10.5	11.4	12.4	13.4	14.4	82.5
83.0	9.8	10.1	10.4	10.8	11.1	11.3	11.5	11.8	12.1	12.4	12.8	13.2	13.4	8.8	9.7	10.6	11.5	12.5	13.5	14.6	83.0
83.5	9.9	10.1	10.5	10.9	11.2	11.4	11.6	11.9	12.2	12.5	12.9	13.3	13.5	8.9	9.8	10.7	11.6	12.6	13.7	14.7	83.5
84.0	10.0	10.2	10.6	11.0	11.3	11.5	11.7	12.0	12.3	12.6	13.0	13.4	13.6	9.0	9.9	10.8	11.7	12.8	13.8	14.8	84.0
84.5	10.1	10.3	10.7	11.1	11.4	11.6	11.8	12.1	12.4	12.7	13.1	13.5	13.8	9.1	10.0	10.9	11.8	12.9	13.9	14.9	84.5

TABLE 9—*Continued*

Length cm	Centiles													Standard deviations							Length cm
	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	
85.0	10.2	10.4	10.8	11.2	11.4	11.7	11.9	12.2	12.5	12.8	13.3	13.6	13.9	9.2	10.1	11.0	11.9	13.0	14.0	15.0	85.0
85.5	10.3	10.5	10.8	11.3	11.5	11.8	12.0	12.3	12.6	12.9	13.4	13.7	14.0	9.3	10.2	11.1	12.0	13.1	14.1	15.1	85.5
86.0	10.4	10.6	10.9	11.4	11.6	11.9	12.1	12.4	12.7	13.0	13.5	13.8	14.1	9.3	10.3	11.2	12.1	13.2	14.2	15.3	86.0
86.5	10.5	10.7	11.0	11.4	11.7	12.0	12.2	12.5	12.8	13.1	13.6	14.0	14.2	9.4	10.4	11.3	12.2	13.3	14.3	15.4	86.5
87.0	10.6	10.8	11.1	11.5	11.8	12.1	12.3	12.6	12.9	13.2	13.7	14.1	14.3	9.5	10.5	11.4	12.3	13.4	14.4	15.5	87.0
87.5	10.7	10.9	11.2	11.6	11.9	12.2	12.4	12.7	13.0	13.3	13.8	14.2	14.4	9.6	10.5	11.5	12.4	13.5	14.6	15.6	87.5
88.0	10.8	11.0	11.3	11.7	12.0	12.3	12.5	12.8	13.1	13.4	13.9	14.3	14.5	9.7	10.6	11.6	12.5	13.6	14.7	15.7	88.0
88.5	10.8	11.1	11.4	11.8	12.2	12.4	12.7	12.9	13.2	13.5	14.0	14.4	14.6	9.8	10.7	11.7	12.7	13.7	14.8	15.8	85.5
89.0	10.9	11.2	11.5	11.9	12.3	12.5	12.8	13.0	13.3	13.7	14.1	14.5	14.8	9.9	10.8	11.8	12.8	13.8	14.9	16.0	89.0
89.5	11.0	11.3	11.6	12.0	12.4	12.6	12.9	13.1	13.4	13.8	14.2	14.6	14.9	10.0	10.9	11.9	12.9	13.9	15.0	16.1	89.5
90.0	11.1	11.4	11.7	12.2	12.5	12.7	13.0	13.2	13.5	13.9	14.3	14.7	15.0	10.0	11.0	12.0	13.0	14.0	15.1	16.2	90.0
90.5	11.2	11.5	11.8	12.3	12.6	12.8	13.1	13.4	13.6	14.0	14.5	14.8	15.1	10.1	11.1	12.1	13.1	14.2	15.2	16.3	90.5
91.0	11.3	11.6	11.9	12.4	12.7	12.9	13.2	13.5	13.8	14.1	14.6	15.0	15.2	10.2	11.2	12.2	13.2	14.3	15.3	16.4	91.0
91.5	11.4	11.7	12.0	12.5	12.8	13.1	13.3	13.6	13.9	14.2	14.7	15.1	15.3	10.3	11.3	12.3	13.3	14.4	15.5	16.5	91.5
92.0	11.5	11.8	12.1	12.6	12.9	13.2	13.4	13.7	14.0	14.3	14.8	15.2	15.5	10.4	11.4	12.4	13.4	14.5	15.6	16.7	92.0
92.5	11.7	11.9	12.3	12.7	13.0	13.3	13.5	13.8	14.1	14.4	14.9	15.3	15.6	10.5	11.5	12.5	13.5	14.6	15.7	16.8	92.5
93.0	11.8	12.0	12.4	12.8	13.1	13.4	13.7	13.9	14.2	14.6	15.0	15.4	15.7	10.6	11.6	12.6	13.7	14.7	15.8	16.9	93.0
93.5	11.9	12.1	12.5	12.9	13.2	13.5	13.8	14.0	14.3	14.7	15.2	15.6	15.8	10.7	11.7	12.8	13.8	14.9	15.9	17.0	93.5

TABLE 9—*Continued*

Lengthe cm	Centiles													Standard deviations							Length cm
	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	
94.0	12.0	12.2	12.6	13.0	13.4	13.6	13.9	14.2	14.5	14.8	15.3	15.7	15.9	10.8	11.9	12.9	13.9	15.0	16.1	17.1	94.0
94.5	12.1	12.3	12.7	13.2	13.5	13.8	14.0	14.3	14.6	14.9	15.4	15.8	16.1	10.9	12.0	13.0	14.0	15.1	16.2	17.3	94.5
95.0	12.2	12.4	12.8	13.3	13.6	13.9	14.1	14.4	14.7	15.1	15.5	15.9	16.2	11.0	12.1	13.1	14.1	15.2	16.3	17.4	95.0
95.5	12.3	12.6	12.9	13.4	13.7	14.0	14.3	14.5	14.8	15.2	15.7	16.1	16.3	11.2	12.2	13.2	14.3	15.4	16.4	17.5	95.5
96.0	12.4	12.7	13.1	13.5	13.8	14.1	14.4	14.7	15.0	15.3	15.8	16.2	16.4	11.3	12.3	13.3	14.4	15.5	16.6	17.7	96.0
96.5	12.5	12.8	13.2	13.6	14.0	14.3	14.5	14.8	15.1	15.4	15.9	16.3	16.6	11.4	12.4	13.5	14.5	15.6	16.7	17.8	96.5
97.0	12.7	12.9	13.3	13.8	14.1	14.4	14.7	14.9	15.2	15.6	16.1	16.4	16.7	11.5	12.5	13.6	14.7	15.7	16.8	17.9	97.0
97.5	12.8	13.0	13.4	13.9	14.2	14.5	14.8	15.1	15.4	15.7	16.2	16.6	16.8	11.6	12.7	13.7	14.8	15.9	17.0	18.1	97.5
98.0	12.9	13.2	13.5	14.0	14.4	14.7	14.9	15.2	15.5	15.8	16.3	16.7	17.0	11.7	12.8	13.9	14.9	16.0	17.1	18.2	98.0
98.5	13.0	13.3	13.7	14.2	14.5	14.8	15.1	15.3	15.6	16.0	16.5	16.9	17.1	11.8	12.9	14.0	15.1	16.2	17.2	18.3	98.5
99.0	13.1	13.4	13.8	14.3	14.6	14.9	15.2	15.5	15.8	16.1	16.6	17.0	17.3	11.9	13.0	14.1	15.2	16.3	17.4	18.5	99.0
99.5	13.3	13.5	13.9	14.4	14.8	15.1	15.4	15.6	15.9	16.3	16.8	17.1	17.4	12.0	13.1	14.2	15.4	16.4	17.5	18.6	99.5
100.0	13.4	13.7	14.1	14.6	14.9	15.2	15.5	15.8	16.1	16.4	16.9	17.3	17.6	12.1	13.3	14.4	15.5	16.6	17.7	18.8	100.0
100.5	13.5	13.8	14.2	14.7	15.1	15.4	15.7	15.9	16.2	16.6	17.1	17.4	17.7	12.2	13.4	14.5	15.7	16.7	17.8	18.9	100.5
101.0	13.6	13.9	14.3	14.8	15.2	15.5	15.8	16.1	16.4	16.7	17.2	17.6	17.9	12.3	13.5	14.7	15.8	16.9	18.0	19.1	101.0
101.5	13.8	14.0	14.5	15.0	15.4	15.7	16.0	16.2	16.5	16.9	17.4	17.8	18.0	12.5	13.6	14.8	16.0	17.1	18.1	19.2	101.5
102.0	13.9	14.2	14.6	15.1	15.5	15.8	16.1	16.4	16.7	17.0	17.5	17.9	18.2	12.6	13.8	14.9	16.1	17.2	18.3	19.4	102.0
102.5	14.0	14.3	14.7	15.3	15.7	16.0	16.3	16.6	16.9	17.2	17.7	18.1	18.3	12.7	13.9	15.1	16.3	17.4	18.5	19.6	102.5
103.0	14.2	14.4	14.9	15.4	15.8	16.1	16.5	16.7	17.0	17.4	17.8	18.2	18.5	12.8	14.0	15.2	16.5	17.5	18.6	19.7	103.0

TABLE 10

Weight (kg) by Stature of Boys 55–145 cm in height

Stature cm	Centiles													Standard deviations							Stature cm
	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	
55.0	2.9	3.1	3.3	3.7	3.9	4.1	4.3	4.6	4.9	5.3	5.9	6.3	6.6	2.0	2.8	3.6	4.3	5.5	6.7	7.9	55.0
55.5	3.0	3.2	3.5	3.8	4.1	4.3	4.5	4.8	5.1	5.5	6.0	6.5	6.8	2.2	2.9	3.7	4.5	5.7	6.9	8.1	55.5
56.0	3.2	3.4	3.7	4.0	4.3	4.5	4.7	5.0	5.3	5.7	6.2	6.7	6.9	2.3	3.1	3.9	4.7	5.9	7.1	8.3	56.0
56.5	3.3	3.5	3.8	4.2	4.4	4.7	4.9	5.2	5.5	5.9	6.4	6.8	7.1	2.4	3.2	4.1	4.9	6.1	7.3	8.4	56.5
57.0	3.5	3.7	4.0	4.3	4.6	4.8	5.0	5.3	5.7	6.0	6.6	7.0	7.3	2.6	3.4	4.2	5.0	6.2	7.4	8.6	57.0
57.5	3.6	3.8	4.1	4.5	4.8	5.0	5.2	5.5	5.8	6.2	6.7	7.2	7.4	2.7	3.5	4.4	5.2	6.4	7.6	8.8	57.5
58.0	3.8	4.0	4.3	4.7	4.9	5.2	5.4	5.7	6.0	6.4	6.9	7.3	7.6	2.8	3.7	4.5	5.4	6.6	7.8	9.0	58.0
58.5	3.9	4.1	4.4	4.8	5.1	5.3	5.5	5.8	6.2	6.5	7.1	7.5	7.8	3.0	3.8	4.7	5.5	6.7	7.9	9.1	58.5
59.0	4.1	4.3	4.6	5.0	5.2	5.5	5.7	6.0	6.3	6.7	7.2	7.7	7.9	3.1	4.0	4.8	5.7	6.9	8.1	9.3	59.0
59.5	4.2	4.4	4.7	5.1	5.4	5.6	5.9	6.2	6.5	6.9	7.4	7.8	8.1	3.2	4.1	5.0	5.9	7.1	8.2	9.4	59.5
60.0	4.4	4.6	4.9	5.3	5.6	5.8	6.0	6.3	6.6	7.0	7.6	8.0	8.3	3.4	4.3	5.1	6.0	7.2	8.4	9.6	60.0
60.5	4.5	4.7	5.0	5.4	5.7	6.0	6.2	6.5	6.8	7.2	7.7	8.1	8.4	3.5	4.4	5.3	6.2	7.4	8.6	9.8	60.5
61.0	4.6	4.8	5.2	5.6	5.9	6.1	6.3	6.6	7.0	7.3	7.9	8.3	8.6	3.6	4.5	5.4	6.3	7.5	8.7	9.9	61.0
61.5	4.8	5.0	5.3	5.7	6.0	6.3	6.5	6.8	7.1	7.5	8.0	8.5	8.7	3.8	4.7	5.6	6.5	7.7	8.9	10.1	61.5
62.0	4.9	5.1	5.5	5.9	6.2	6.4	6.6	6.9	7.3	7.6	8.2	8.6	8.9	3.9	4.8	5.7	6.6	7.8	9.0	10.2	62.0
62.5	5.0	5.3	5.6	6.0	6.3	6.5	6.8	7.1	7.4	7.8	8.3	8.8	9.1	4.0	4.9	5.9	6.8	8.0	9.2	10.4	62.5
63.0	5.2	5.4	5.7	6.1	6.4	6.7	6.9	7.2	7.6	7.9	8.5	8.9	9.2	4.1	5.1	6.0	6.9	8.1	9.3	10.6	63.0
63.5	5.3	5.5	5.9	6.3	6.6	6.8	7.1	7.4	7.7	8.1	8.6	9.1	9.4	4.3	5.2	6.1	7.1	8.3	9.5	10.7	63.5
64.0	5.4	5.7	6.0	6.4	6.7	7.0	7.2	7.5	7.8	8.2	8.8	9.2	9.5	4.4	5.3	6.3	7.2	8.4	9.6	10.9	64.0
64.5	5.6	5.8	6.1	6.5	6.8	7.1	7.3	7.7	8.0	8.4	8.9	9.4	9.7	4.5	5.5	6.4	7.3	8.6	9.8	11.0	64.5
65.0	5.7	5.9	6.3	6.7	7.0	7.2	7.5	7.8	8.1	8.5	9.1	9.5	9.8	4.6	5.6	6.5	7.5	8.7	9.9	11.2	65.0
65.5	5.8	6.0	6.4	6.8	7.1	7.4	7.6	7.9	8.3	8.7	9.2	9.7	9.9	4.7	5.7	6.7	7.6	8.9	10.1	11.3	65.5
66.0	5.9	6.2	6.5	6.9	7.2	7.5	7.7	8.1	8.4	8.8	9.3	9.8	10.1	4.9	5.8	6.8	7.7	9.0	10.2	11.5	66.0
66.5	6.1	6.3	6.6	7.1	7.4	7.6	7.9	8.2	8.5	8.9	9.5	9.9	10.2	5.0	6.0	6.9	7.9	9.1	10.4	11.6	66.5

TABLE 10—*Continued*

Stature cm	Centiles													Standard deviations							Stature cm
	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	
67.0	6.2	6.4	6.8	7.2	7.5	7.8	8.0	8.3	8.7	9.1	9.6	10.1	10.4	5.1	6.1	7.0	8.0	9.3	10.5	11.8	67.0
67.5	6.3	6.5	6.9	7.3	7.6	7.9	8.1	8.5	8.8	9.2	9.8	10.2	10.5	5.2	6.2	7.2	8.1	9.4	10.7	11.9	67.5
68.0	6.4	6.7	7.0	7.4	7.8	8.0	8.3	8.6	8.9	9.3	9.9	10.4	10.7	5.3	6.3	7.3	8.3	9.5	10.8	12.1	68.0
68.5	6.6	6.8	7.1	7.6	7.9	8.1	8.4	8.7	9.1	9.5	10.0	10.5	10.8	5.5	6.4	7.4	8.4	9.7	10.9	12.2	68.5
69.0	6.7	6.9	7.3	7.7	8.0	8.3	8.5	8.8	9.2	9.6	10.2	10.6	10.9	5.6	6.6	7.5	8.5	9.8	11.1	12.4	69.0
69.5	6.8	7.0	7.4	7.8	8.1	8.4	8.6	9.0	9.3	9.7	10.3	10.8	11.1	5.7	6.7	7.7	8.6	9.9	11.2	12.5	69.5
70.0	6.9	7.1	7.5	7.9	8.2	8.5	8.8	9.1	9.4	9.8	10.4	10.9	11.2	5.8	6.8	7.8	8.8	10.1	11.4	12.7	70.0
70.5	7.0	7.3	7.6	8.0	8.4	8.6	8.9	9.2	9.6	10.0	10.5	11.0	11.3	5.9	6.9	7.9	8.9	10.2	11.5	12.8	70.5
71.0	7.1	7.4	7.7	8.2	8.5	8.7	9.0	9.3	9.7	10.1	10.7	11.2	11.5	6.0	7.0	8.0	9.0	10.3	11.6	12.9	71.0
71.5	7.2	7.5	7.8	8.3	8.6	8.9	9.1	9.4	9.8	10.2	10.8	11.3	11.6	6.1	7.1	8.1	9.1	10.4	11.8	13.1	71.5
72.0	7.4	7.6	8.0	8.4	8.7	9.0	9.2	9.6	9.9	10.3	10.9	11.4	11.7	6.3	7.2	8.2	9.2	10.6	11.9	13.2	72.0
75.5	7.5	7.7	8.1	8.5	8.8	9.1	9.3	9.7	10.0	10.5	11.1	11.5	11.9	6.4	7.4	8.3	9.3	10.7	12.0	13.4	72.5
73.0	7.6	7.8	8.2	8.6	8.9	9.2	9.5	9.8	10.2	10.6	11.2	11.7	12.0	6.5	7.5	8.5	9.5	10.8	12.1	13.5	73.0
73.5	7.7	7.9	8.3	8.7	9.0	9.3	9.6	9.9	10.3	10.7	11.3	11.8	12.1	6.6	7.6	8.6	9.6	10.9	12.3	13.6	73.5
74.0	7.8	8.0	8.4	8.8	9.2	9.4	9.7	10.0	10.4	10.8	11.4	11.9	12.2	6.7	7.7	8.7	9.7	11.0	12.4	13.8	74.0
74.5	7.9	8.2	8.5	9.0	9.3	9.5	9.8	10.1	10.5	10.9	11.5	12.0	12.4	6.8	7.8	8.8	9.8	11.2	12.5	13.9	74.5
75.0	8.0	8.3	8.6	9.1	9.4	9.7	9.9	10.3	10.6	11.1	11.7	12.2	12.5	6.9	7.9	8.9	9.9	11.3	12.7	14.0	75.0
75.5	8.1	8.4	8.7	9.2	9.5	9.8	10.0	10.4	10.7	11.2	11.8	12.3	12.6	7.0	8.0	9.0	10.0	11.4	12.8	14.2	75.5
76.0	8.2	8.5	8.8	9.3	9.6	9.9	10.1	10.5	10.9	11.3	11.9	12.4	12.7	7.1	8.1	9.1	10.1	11.5	12.9	14.3	76.0
76.5	8.3	8.6	8.9	9.4	9.7	10.0	10.2	10.6	11.0	11.4	12.0	12.5	12.9	7.2	8.2	9.2	10.2	11.6	13.0	14.4	76.5
77.0	8.4	8.7	9.1	9.5	9.8	10.1	10.4	10.7	11.1	11.5	12.1	12.7	13.0	7.3	8.3	9.3	10.4	11.8	13.2	14.5	77.0
77.5	8.6	8.8	9.2	9.6	9.9	10.2	10.5	10.8	11.2	11.6	12.3	12.8	13.1	7.4	8.4	9.4	10.5	11.9	13.3	14.7	77.5
78.0	8.7	8.9	9.3	9.7	10.0	10.3	10.6	10.9	11.3	11.8	12.4	12.9	13.2	7.5	8.5	9.6	10.6	12.0	13.4	14.8	78.0
78.5	8.8	9.0	9.4	9.8	10.1	10.4	10.7	11.0	11.4	11.9	12.5	13.0	13.3	7.6	8.6	9.7	10.7	12.1	13.5	14.9	78.5

TABLE 10—*Continued*

Stature cm	Centiles													Standard deviations							Stature cm
	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	
79.0	8.9	9.1	9.5	9.9	10.3	10.5	10.8	11.2	11.5	12.0	12.6	13.1	13.5	7.7	8.7	9.8	10.8	12.2	13.6	15.1	79.0
79.5	9.0	9.2	9.6	10.0	10.4	10.6	10.9	11.3	11.6	12.1	12.7	13.2	13.6	7.8	8.8	9.9	10.9	12.3	13.8	15.2	79.5
80.0	9.1	9.3	9.7	10.1	10.5	10.8	11.0	11.4	11.8	12.2	12.8	13.4	13.7	7.9	8.9	10.0	11.0	12.4	13.9	15.3	80.0
80.5	9.2	9.4	9.8	10.2	10.6	10.9	11.1	11.5	11.9	12.3	13.0	13.5	13.8	8.0	9.0	10.1	11.1	12.6	14.0	15.4	80.5
81.0	9.3	9.5	9.9	10.4	10.7	11.0	11.2	11.6	12.0	12.4	13.1	13.6	13.9	8.1	9.1	10.2	11.2	12.7	14.1	15.5	81.0
81.5	9.4	9.6	10.0	10.5	10.8	11.1	11.3	11.7	12.1	12.6	13.2	13.7	14.1	8.2	9.2	10.3	11.3	12.8	14.2	15.7	81.5
82.0	9.5	9.7	10.1	10.6	10.9	11.2	11.5	11.8	12.2	12.7	13.3	13.8	14.2	8.3	9.3	10.4	11.5	12.9	14.3	15.8	82.0
82.5	9.6	9.8	10.2	10.7	11.0	11.3	11.6	11.9	12.3	12.8	13.4	13.9	14.3	8.4	9.4	10.5	11.6	13.0	14.5	15.9	82.5
83.0	9.7	9.9	10.3	10.8	11.1	11.4	11.7	12.0	12.4	12.9	13.5	14.1	14.4	8.5	9.5	10.6	11.7	13.1	14.6	16.0	83.0
83.5	9.8	10.0	10.4	10.9	11.2	11.5	11.8	12.2	12.5	13.0	13.6	14.2	14.5	8.6	9.6	10.7	11.8	13.2	14.7	16.1	83.5
84.0	9.9	10.1	10.5	11.0	11.3	11.6	11.9	12.3	12.7	13.1	13.8	14.3	14.6	8.7	9.7	10.8	11.9	13.3	14.8	16.2	84.0
84.5	10.0	10.2	10.6	11.1	11.4	11.7	12.0	12.4	12.8	13.2	13.9	14.4	14.7	8.8	9.8	10.9	12.0	13.5	14.9	16.4	84.5
85.0	10.1	10.3	10.7	11.2	11.5	11.8	12.1	12.5	12.9	13.3	14.0	14.5	14.9	8.9	9.9	11.0	12.1	13.6	15.0	16.5	85.0
85.5	10.2	10.4	10.8	11.3	11.7	12.0	12.2	12.6	13.0	13.5	14.1	14.6	15.0	8.9	10.0	11.1	12.2	13.7	15.1	16.6	85.5
86.0	10.3	10.5	10.9	11.4	11.8	12.1	12.3	12.7	13.1	13.6	14.2	14.7	15.1	9.0	10.1	11.2	12.3	13.8	15.3	16.7	86.0
86.5	10.4	10.6	11.0	11.5	11.9	12.2	12.5	12.8	13.2	13.7	14.3	14.9	15.2	9.1	10.2	11.3	12.5	13.9	15.4	16.8	86.5
87.0	10.5	10.7	11.1	11.6	12.0	12.3	12.6	12.9	13.3	13.8	14.4	15.0	15.3	9.2	10.3	11.5	12.6	14.0	15.5	16.9	87.0
87.5	10.6	10.8	11.2	11.7	12.1	12.4	12.7	13.1	13.4	13.9	14.6	15.1	15.4	9.3	10.4	11.6	12.7	14.1	15.6	17.1	87.5
88.0	10.7	10.9	11.3	11.8	12.2	12.5	12.8	13.2	13.6	14.0	14.7	15.2	15.5	9.4	10.5	11.7	12.8	14.3	15.7	17.2	88.0
88.5	10.8	11.0	11.5	12.0	12.3	12.6	12.9	13.3	13.7	14.1	14.8	15.3	15.7	9.5	10.6	11.8	12.9	14.4	15.8	17.3	85.5
89.0	10.9	11.1	11.6	12.1	12.4	12.7	13.0	13.4	13.8	14.3	14.9	15.4	15.8	9.6	10.7	11.9	13.0	14.5	16.0	17.4	89.0
89.5	11.0	11.2	11.7	12.2	12.5	12.9	13.1	13.5	13.9	14.4	15.0	15.5	15.9	9.7	10.8	12.0	13.1	14.6	16.1	17.5	89.5
90.0	11.1	11.3	11.8	12.3	12.6	13.0	13.3	13.6	14.0	14.5	15.1	15.7	16.0	9.8	10.9	12.1	13.3	14.7	16.2	17.6	90.0
90.5	11.2	11.4	11.9	12.4	12.8	13.1	13.4	13.7	14.1	14.6	15.3	15.8	16.1	9.9	11.0	12.2	13.4	14.8	16.3	17.8	90.5

TABLE 10—*Continued*

Stature cm	Centiles													Standard deviations							Stature cm
	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	
91.0	11.3	11.5	12.0	12.5	12.9	13.2	13.5	13.9	14.3	14.7	15.4	15.9	16.2	9.9	11.1	12.3	13.5	15.0	16.4	17.9	91.0
91.5	11.4	11.7	12.1	12.6	13.0	13.3	13.6	14.0	14.4	14.8	15.5	16.0	16.4	10.0	11.2	12.4	13.6	15.1	16.5	18.0	91.5
92.0	11.5	11.8	12.2	12.7	13.1	13.4	13.7	14.1	14.5	15.0	15.6	16.1	16.5	10.1	11.3	12.5	13.7	15.2	16.7	18.1	92.0
92.5	11.6	11.9	12.3	12.8	13.2	13.5	13.9	14.2	14.6	15.1	15.7	16.3	16.6	10.2	11.4	12.6	13.9	15.3	16.8	18.3	92.5
93.0	11.7	12.0	12.4	12.9	13.3	13.7	14.0	14.3	14.7	15.2	15.9	16.4	16.7	10.3	11.5	12.8	14.0	15.4	16.9	18.4	93.0
93.5	11.8	12.1	12.5	13.1	13.4	13.8	14.1	14.5	14.9	15.3	16.0	16.5	16.9	10.4	11.6	12.9	14.1	15.6	17.0	18.5	93.5
94.0	11.9	12.2	12.6	13.2	13.6	13.9	14.2	14.6	15.0	15.5	16.1	16.6	17.0	10.5	11.7	13.0	14.2	15.7	17.2	18.6	94.0
94.5	12.0	12.3	12.7	13.3	13.7	14.0	14.3	14.7	15.1	15.6	16.2	16.8	17.1	10.6	11.8	13.1	14.3	15.8	17.3	18.8	94.5
95.0	12.1	12.4	12.8	13.4	13.8	14.1	14.5	14.8	15.2	15.7	16.4	16.9	17.2	10.7	11.9	13.2	14.5	15.9	17.4	18.9	95.0
95.5	12.2	12.5	13.0	13.5	13.9	14.3	14.6	15.0	15.4	15.8	16.5	17.0	17.4	10.8	12.0	13.3	14.6	16.1	17.5	19.0	95.5
96.0	12.3	12.6	13.1	13.6	14.0	14.4	14.7	15.1	15.5	16.0	16.6	17.1	17.5	10.9	12.1	13.4	14.7	16.2	17.7	19.2	96.0
96.5	12.4	12.7	13.2	13.7	14.2	14.5	14.8	15.2	15.6	16.1	16.7	17.3	17.6	11.0	12.2	13.5	14.8	16.3	17.8	19.3	96.5
97.0	12.5	12.8	13.3	13.9	14.3	14.6	15.0	15.3	15.7	16.2	16.9	17.4	17.8	11.0	12.4	13.7	15.0	16.5	17.9	19.4	97.0
97.5	12.6	12.9	13.4	14.0	14.4	14.8	15.1	15.5	15.9	16.3	17.0	17.5	17.9	11.1	12.5	13.8	15.1	16.6	18.1	19.6	97.5
98.0	12.7	13.0	13.5	14.1	14.5	15.9	15.2	15.6	16.0	16.5	17.1	17.7	18.0	11.2	12.6	13.9	15.2	16.7	18.2	19.7	98.0
98.5	12.8	13.1	13.6	14.2	14.6	15.0	15.4	15.7	16.1	16.6	17.3	17.8	18.2	11.3	12.7	14.0	15.4	16.9	18.4	19.9	98.5
99.0	12.9	13.3	13.8	14.3	14.8	15.1	15.5	15.9	16.3	16.8	17.4	18.0	18.3	11.4	12.8	14.1	15.5	17.0	18.5	20.0	99.0
99.5	13.1	13.4	13.9	14.5	14.9	15.3	15.6	16.0	16.4	16.9	17.6	18.1	18.5	11.5	12.9	14.3	15.6	17.1	18.6	20.2	99.5
100.0	13.2	13.5	14.0	14.6	15.0	15.4	15.7	16.1	16.5	17.0	17.7	18.2	18.6	11.6	13.0	14.4	15.7	17.3	18.8	20.3	100.0
100.5	13.3	13.6	14.1	14.7	15.2	15.5	15.9	16.3	16.7	17.2	17.8	18.4	18.8	11.7	13.1	14.5	15.9	17.4	18.9	20.5	100.5
101.0	13.4	13.7	14.2	14.8	15.3	15.7	16.0	16.4	16.8	17.3	18.0	18.5	18.9	11.8	13.2	14.6	16.0	17.5	19.1	20.6	101.0
101.5	13.5	13.8	14.3	15.0	15.4	15.8	16.2	16.5	17.0	17.4	18.1	18.7	19.1	11.9	13.3	14.7	16.2	17.7	19.2	20.8	101.5
102.0	13.6	14.0	14.5	15.1	15.5	15.9	16.3	16.7	17.1	17.6	18.3	18.8	19.2	12.0	13.4	14.9	16.3	17.8	19.4	20.9	102.0
102.5	13.7	14.1	14.6	15.2	15.7	16.1	16.4	16.8	17.2	17.7	18.4	19.0	19.4	12.1	13.6	15.0	16.4	18.0	19.5	21.1	102.5

TABLE 10—*Continued*

Stature cm	Centiles													Standard deviations							Stature cm
	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	
103.0	13.9	14.2	14.7	15.4	15.8	16.2	16.6	17.0	17.4	17.9	18.6	19.1	19.5	12.2	13.7	15.1	16.6	18.1	19.7	21.3	103.0
103.5	14.0	14.3	14.8	15.5	15.9	16.3	16.7	17.1	17.5	18.0	18.7	19.3	19.7	12.3	13.8	15.3	16.7	18.3	19.9	21.4	103.5
104.0	14.1	14.4	15.0	15.6	16.1	16.5	16.9	17.3	17.7	18.2	18.9	19.5	19.8	12.4	13.9	15.4	16.9	18.4	20.0	21.6	104.0
104.5	14.2	14.6	15.1	15.7	16.2	16.6	17.0	17.4	17.8	18.3	19.0	19.6	20.0	12.6	14.0	15.5	17.0	18.6	20.2	21.8	104.5
105.0	14.3	14.7	15.2	15.9	16.4	16.8	17.1	17.5	18.0	18.5	19.2	19.8	20.2	12.7	14.2	15.6	17.1	18.8	20.4	22.0	105.0
105.5	14.5	14.8	15.4	16.0	16.5	16.9	17.3	17.7	18.1	18.7	19.4	20.0	20.3	12.8	14.3	15.8	17.3	18.9	20.5	22.2	105.5
106.0	14.6	14.9	15.5	16.2	16.6	17.0	17.4	17.8	18.3	18.8	19.5	20.1	20.5	12.9	14.4	15.9	17.4	19.1	20.7	22.4	106.0
106.5	14.7	15.1	15.6	16.3	16.8	17.2	17.6	18.0	18.4	19.0	19.7	20.3	20.7	13.0	14.5	16.1	17.6	19.2	20.9	22.5	106.5
107.0	14.8	15.2	15.8	16.4	16.9	17.3	17.7	18.2	18.6	19.1	19.9	20.5	20.9	13.1	14.7	16.2	17.8	19.4	21.1	22.7	107.0
107.5	15.0	15.3	15.9	16.6	17.1	17.5	17.9	18.3	18.8	19.3	20.0	20.7	21.1	13.2	14.8	16.3	17.9	19.6	21.3	22.9	107.5
108.0	15.1	15.5	16.0	16.7	17.2	17.6	18.0	18.5	18.9	19.5	20.2	20.8	21.2	13.4	14.9	16.5	18.0	19.7	21.4	23.1	108.0
108.5	15.2	15.6	16.2	16.9	17.4	17.8	18.2	18.6	19.1	19.6	20.4	21.0	21.4	13.5	15.0	16.6	18.2	19.9	21.6	23.4	108.5
109.0	15.4	15.7	16.3	17.0	17.5	17.9	18.3	18.8	19.3	19.8	20.6	21.2	21.6	13.6	15.2	16.8	18.3	20.1	21.8	23.6	109.0
109.5	15.5	15.9	16.5	17.2	17.7	18.1	18.5	18.9	19.4	20.0	20.8	21.4	21.8	13.7	15.3	16.9	18.5	20.3	22.0	23.8	109.5
110.0	15.6	16.0	16.6	17.3	17.8	18.3	18.7	19.1	19.6	20.2	20.9	21.6	22.0	13.8	15.4	17.1	18.7	20.4	22.2	24.0	110.0
110.5	15.8	16.2	16.7	17.5	18.0	18.4	18.8	19.3	19.8	20.3	21.1	21.8	22.2	14.0	15.6	17.2	18.8	20.6	22.4	24.2	110.5
111.0	15.9	16.3	16.9	17.6	18.1	18.6	19.0	19.4	19.9	20.5	21.3	22.0	22.4	14.1	15.7	17.4	19.0	20.8	22.6	24.5	111.0
111.5	16.1	16.4	17.0	17.8	18.3	18.7	19.1	19.6	20.1	20.7	21.5	22.2	22.6	14.2	15.9	17.5	19.1	21.0	22.8	24.7	111.5
112.0	16.2	16.6	17.2	17.9	18.4	18.9	19.3	19.8	20.3	20.9	21.7	22.4	22.8	14.4	16.0	17.7	19.3	21.2	23.1	24.9	112.0
112.5	16.3	16.7	17.3	18.1	18.6	19.1	19.5	20.0	20.5	21.1	21.9	22.6	23.1	14.5	16.1	17.8	19.5	21.4	23.3	25.2	112.5
113.0	16.5	16.9	17.5	18.2	18.8	19.2	19.6	20.1	20.7	21.3	22.1	22.8	23.3	14.6	16.3	18.0	19.6	21.6	23.5	25.4	113.0
113.5	16.6	17.0	17.7	18.4	18.9	19.4	19.8	20.3	20.8	21.5	22.3	23.0	23.5	14.8	16.4	18.1	19.8	21.8	23.7	25.7	113.5
114.0	16.8	17.2	17.8	18.6	19.1	19.6	20.0	20.5	21.0	21.7	22.5	23.3	23.7	14.9	16.6	18.3	20.0	22.0	24.0	25.9	114.0
114.5	16.9	17.4	18.0	18.7	19.3	19.7	20.2	20.7	21.2	21.9	22.7	23.5	24.0	15.0	16.7	18.5	20.2	22.2	24.2	26.2	114.5

TABLE 10—*Continued*

Stature	Centiles													Standard deviations							Stature
cm	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	cm
115.0	17.1	17.5	18.1	18.9	19.4	19.9	20.3	20.9	21.4	22.1	23.0	23.7	24.2	15.2	16.9	18.6	20.3	22.4	24.4	26.5	115.0
115.5	17.3	17.7	18.3	19.1	19.6	20.1	20.5	21.0	21.6	22.3	23.2	23.9	24.4	15.3	17.1	18.8	20.5	22.6	24.7	26.8	115.5
116.0	17.4	17.8	18.5	19.2	19.8	20.2	20.7	21.2	21.8	22.5	23.4	24.2	24.7	15.5	17.2	18.9	20.7	22.8	24.9	27.0	116.0
116.5	17.6	18.0	18.6	19.4	20.0	20.4	20.9	21.4	22.0	22.7	23.6	24.4	24.9	15.6	17.4	19.1	20.9	23.0	25.2	27.3	116.5
117.0	17.7	18.2	18.8	19.6	20.1	20.6	21.1	21.6	22.2	22.9	23.9	24.7	25.2	15.8	17.5	19.3	21.1	23.2	25.4	27.6	117.0
117.5	17.9	18.3	19.0	19.7	20.3	20.8	21.2	21.8	22.4	23.1	24.1	24.9	25.4	15.9	17.7	19.5	21.2	23.5	25.7	27.9	117.5
118.0	18.1	18.5	19.1	19.9	20.5	21.0	21.4	22.0	22.6	23.3	24.3	25.2	25.7	16.1	17.9	19.6	21.4	23.7	26.0	28.2	118.0
118.5	18.2	18.7	19.3	20.1	20.7	21.2	21.6	22.2	22.8	23.6	24.6	25.4	26.0	16.2	18.0	19.8	21.6	23.9	26.2	28.5	118.5
119.0	18.4	18.8	19.5	20.3	20.9	21.3	21.8	22.4	23.0	23.8	24.8	25.7	26.2	16.4	18.2	20.0	21.8	24.2	26.5	28.8	119.0
119.5	18.6	19.0	19.7	20.5	21.0	21.5	22.0	22.6	23.3	24.0	25.1	25.9	26.5	16.6	18.4	20.2	22.0	24.4	26.8	29.2	119.5
120.0	18.8	19.2	19.9	20.7	21.2	21.7	22.2	22.8	23.5	24.2	25.3	26.2	26.8	16.7	18.5	20.4	22.2	24.6	27.1	29.5	120.0
120.5	18.9	19.4	20.0	20.8	21.4	21.9	22.4	23.0	23.7	24.5	25.6	26.5	27.1	16.9	18.7	20.6	22.4	24.9	27.4	29.8	120.5
121.0	19.1	19.5	20.2	21.0	21.6	22.1	22.6	23.2	23.9	24.7	25.8	26.7	27.3	17.0	18.9	20.7	22.6	25.1	27.6	30.2	121.0
121.5	19.3	19.7	20.4	21.2	21.8	22.3	22.8	23.4	24.1	25.0	26.1	27.0	27.6	17.2	19.1	20.9	22.8	25.4	27.9	30.5	121.5
122.0	19.5	19.9	20.6	21.4	22.0	22.5	23.0	23.7	24.4	25.2	26.4	27.3	27.9	17.4	19.2	21.1	23.0	25.6	28.3	30.9	122.0
122.5	19.7	20.1	20.8	21.6	22.2	22.7	23.2	23.9	24.6	25.5	26.6	27.6	28.2	17.5	19.4	21.3	23.2	25.9	28.6	31.2	122.5
123.0	19.8	20.3	21.0	21.8	22.4	22.9	23.4	24.1	24.9	25.7	26.9	27.9	28.6	17.7	19.6	21.5	23.4	26.2	28.9	31.6	123.0
123.5	20.0	20.5	21.2	22.0	22.6	23.2	23.6	24.3	25.1	26.0	27.2	28.2	28.9	17.9	19.8	21.7	23.6	26.4	29.2	32.0	123.5
124.0	20.2	20.7	21.4	22.2	22.8	22.8	23.9	24.6	25.3	26.2	27.5	28.5	29.2	18.0	20.0	21.9	23.9	26.7	29.5	32.4	124.0
124.5	20.4	20.9	21.6	22.4	23.1	23.6	24.1	24.8	25.6	26.5	27.8	28.8	29.5	18.2	20.2	22.1	24.1	27.0	29.9	32.7	124.5
125.0	20.6	21.1	21.8	22.6	23.3	23.8	24.3	25.1	25.9	26.8	28.1	29.1	29.8	18.4	20.4	22.3	24.3	27.2	30.2	33.1	125.0
125.5	20.8	21.3	22.0	22.9	23.5	24.0	24.5	25.3	26.1	27.1	28.4	29.5	30.2	18.6	20.5	22.5	24.5	27.5	30.5	33.5	125.5
126.0	21.0	21.5	22.2	23.1	23.7	24.3	24.8	25.5	26.4	27.3	28.7	29.8	30.5	18.7	20.7	22.8	24.8	27.8	30.9	33.9	126.0
126.5	21.2	21.7	22.4	23.3	23.9	24.5	25.0	25.8	26.6	27.6	29.0	30.1	30.9	18.9	20.9	23.0	25.0	28.1	31.2	34.4	126.5

TABLE 10—*Continued*

Stature cm	Centiles													Standard deviations							Stature cm
	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	
127.0	21.4	21.9	22.6	23.5	24.2	24.7	25.2	26.0	26.9	27.9	29.3	30.5	31.2	19.1	21.1	23.2	25.2	28.4	31.6	34.8	127.0
127.5	21.6	22.1	22.8	23.7	24.4	25.0	25.5	26.3	27.2	28.2	29.6	30.8	31.6	19.2	21.3	23.4	25.5	28.7	32.0	35.2	127.5
128.0	21.8	22.3	23.0	24.0	24.6	25.2	25.7	26.6	27.5	28.5	30.0	31.2	31.9	19.4	21.5	23.6	25.7	29.0	32.3	35.6	128.0
128.5	22.0	22.5	23.2	24.2	24.9	25.4	26.0	26.8	27.7	28.8	30.3	31.5	32.3	19.6	21.7	23.8	26.0	29.3	32.7	36.1	128.5
129.0	22.2	22.7	23.5	24.4	25.1	25.7	26.2	27.1	28.0	29.1	30.6	31.9	32.7	19.8	21.9	24.1	26.2	29.7	33.1	36.5	129.0
129.5	22.4	22.9	23.7	24.7	25.3	25.9	26.5	27.4	28.3	29.4	31.0	32.2	33.1	19.9	22.1	24.3	26.5	30.0	33.5	37.0	129.5
130.0	22.6	23.1	23.9	24.9	25.6	26.2	26.8	27.7	28.6	29.8	31.3	32.6	33.5	20.1	22.3	24.5	26.8	30.3	33.9	37.5	130.0
130.5	22.8	23.3	24.1	25.1	25.8	26.5	27.0	27.9	28.9	30.1	31.7	33.0	33.9	20.3	22.5	24.8	27.0	30.7	34.3	37.9	130.5
131.0	23.0	23.5	24.4	25.4	26.1	26.7	27.3	28.2	29.2	30.4	32.0	33.4	34.3	20.4	27.7	25.0	27.3	31.0	34.7	38.4	131.0
131.5	23.2	23.8	24.6	25.6	26.4	27.0	27.6	28.5	29.5	30.7	32.4	33.8	34.7	20.6	22.9	25.2	27.6	31.3	35.1	38.9	131.5
132.0	23.4	24.0	24.8	25.9	26.6	27.3	27.8	28.8	29.9	31.1	32.8	34.2	35.1	20.8	23.1	25.5	27.8	31.7	35.5	39.4	132.0
132.5	23.6	24.2	25.1	26.1	26.9	27.5	28.1	29.1	30.2	31.4	33.2	34.6	35.5	21.0	23.3	25.7	28.1	32.1	36.0	39.9	132.5
133.0	23.8	24.4	25.3	26.4	27.1	27.8	28.4	29.4	30.5	31.8	33.5	35.0	35.9	21.1	23.6	26.0	28.4	32.4	36.4	40.4	133.0
133.5	24.1	24.6	25.5	26.6	27.4	28.1	28.7	29.7	30.8	32.1	33.9	35.4	36.4	21.3	23.8	26.2	28.7	32.8	36.9	40.9	133.5
134.0	24.3	24.9	25.8	26.9	27.7	28.4	29.0	30.1	31.2	32.5	34.3	35.8	36.8	21.5	24.0	26.5	29.0	33.2	37.3	41.5	134.0
134.5	24.5	25.1	26.0	27.2	28.0	28.7	29.3	30.4	31.5	32.9	34.7	36.3	37.3	21.6	24.2	26.7	29.3	33.5	37.8	42.0	134.5
135.0	24.7	25.3	26.3	27.4	28.2	29.0	29.6	30.7	31.9	33.2	35.1	36.7	37.7	21.8	24.4	27.0	29.6	33.9	38.2	42.5	135.0
135.5	24.9	25.6	26.5	27.7	28.5	29.3	29.9	31.0	32.2	33.6	35.6	37.2	38.2	22.0	24.6	27.3	29.9	34.3	38.7	43.1	135.5
136.0	25.2	25.8	26.8	28.0	28.8	29.6	30.2	31.4	32.6	34.0	36.0	37.6	38.7	22.1	24.8	27.5	30.2	34.7	39.2	43.7	136.0
136.5	25.4	26.0	27.0	28.2	29.1	29.9	30.6	31.7	33.0	34.4	36.4	38.1	39.1	22.3	25.0	27.8	30.6	35.1	39.7	44.2	136.5
137.0	25.6	26.3	27.3	28.5	29.4	30.2	30.9	32.1	33.3	34.8	36.8	38.5	39.6	22.4	25.3	28.1	30.9	35.5	40.2	44.8	137.0
137.5	25.8	26.5	27.5	28.8	29.7	30.5	31.2	32.4	33.7	35.2	37.3	39.0	40.1	22.6	25.5	28.4	31.2	36.0	40.7	45.4	137.5
138.0	26.0	26.7	27.8	29.1	30.0	30.8	31.6	32.8	34.1	35.6	37.7	39.5	40.6	22.8	25.7	28.6	31.6	36.4	41.2	46.0	138.0
138.5	26.3	27.0	28.1	29.4	30.3	31.1	31.9	33.1	34.5	36.0	38.2	40.0	41.1	22.9	25.9	28.9	31.9	36.8	41.7	46.6	138.5

TABLE 10—*Continued*

Stature cm	Centiles													Standard deviations							Stature cm
	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	
139.0	26.5	27.2	28.3	29.7	30.6	31.5	32.3	33.5	34.9	36.5	38.7	40.5	41.6	23.1	26.1	29.2	32.3	37.2	42.2	47.2	139.0
139.5	26.7	27.5	28.6	30.0	31.0	31.8	32.6	33.9	35.3	36.9	39.1	41.0	42.2	23.2	26.4	29.5	32.6	37.7	42.8	47.9	139.5
140.0	27.0	27.7	28.9	30.3	31.3	32.2	33.0	34.3	35.7	37.3	39.6	41.5	42.7	23.4	26.6	29.8	33.0	38.1	43.3	48.5	140.0
140.5	27.2	28.0	29.1	30.6	31.6	32.5	33.3	34.7	36.1	37.8	40.1	42.0	43.2	23.5	26.8	30.1	33.3	38.6	43.9	49.1	140.5
141.0	27.4	28.2	29.4	30.9	31.9	32.9	33.7	35.1	36.5	38.2	40.6	42.5	43.8	23.7	27.0	30.4	33.7	39.1	44.4	49.8	141.0
141.5	27.6	28.5	29.7	31.2	32.3	33.2	34.1	35.5	36.9	38.7	41.1	43.1	44.3	23.8	27.2	30.7	34.1	39.5	45.0	50.5	141.5
142.0	27.9	28.7	30.0	31.5	32.6	33.6	34.5	35.9	37.4	39.1	41.6	43.6	44.9	24.0	27.5	31.0	34.5	40.0	45.6	51.1	142.0
142.5	28.1	29.0	30.3	31.8	33.0	33.9	34.8	36.3	37.8	39.6	42.1	44.1	45.5	24.1	27.7	31.3	34.8	40.5	46.2	51.8	142.5
143.0	28.3	29.2	30.5	32.2	33.3	34.3	35.2	36.7	38.3	40.1	42.6	44.7	46.1	24.2	27.9	31.6	35.2	41.0	46.7	52.5	143.0
143.5	28.6	29.5	30.8	32.5	33.7	34.7	35.6	37.1	38.7	40.6	43.1	45.3	46.7	24.4	28.1	31.9	35.6	41.5	47.3	53.2	143.5
144.0	28.8	29.7	31.1	32.8	34.0	35.1	36.1	37.6	39.2	41.1	43.7	45.8	47.2	24.5	28.4	32.2	36.1	42.0	48.0	53.9	144.0
144.5	29.1	30.0	31.4	33.1	34.4	35.5	36.5	38.0	39.6	41.6	44.2	46.4	47.9	24.7	28.6	32.5	36.5	42.5	48.6	54.6	144.5
145.0	29.3	30.2	31.7	33.5	34.8	35.9	36.9	38.4	40.1	42.1	44.8	47.0	48.5	24.8	28.8	32.8	36.9	43.0	49.2	55.4	145.0

TABLE 11

Weight (kg) by Length of Girls 49–101 cm in height

Length	Centiles													Standard deviations							Length
cm	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	cm
49.0	2.6	2.7	2.8	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.9	3.9	2.2	2.6	2.9	3.3	3.6	4.0	4.3	49.0
49.5	2.6	2.7	2.9	3.0	3.2	3.3	3.4	3.4	3.5	3.7	3.8	4.0	4.0	2.2	2.6	3.0	3.4	3.7	4.1	4.5	49.5
50.0	2.7	2.8	2.9	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.9	4.1	4.1	2.3	2.6	3.0	3.4	3.8	4.2	4.6	50.0
50.5	2.7	2.8	3.0	3.1	3.3	3.4	3.5	3.6	3.7	3.8	4.0	4.2	4.3	2.3	2.7	3.1	3.5	3.9	4.3	4.7	50.5
51.0	2.8	2.9	3.0	3.2	3.3	3.4	3.5	3.7	3.8	3.9	4.1	4.3	4.4	2.3	2.7	3.1	3.5	4.0	4.4	4.9	51.0
51.5	2.8	2.9	3.1	3.3	3.4	3.5	3.6	3.7	3.9	4.0	4.2	4.4	4.5	2.4	2.8	3.2	3.6	4.1	4.5	5.0	51.5
52.0	2.9	3.0	3.2	3.3	3.5	3.6	3.7	3.8	4.0	4.1	4.3	4.5	4.6	2.4	2.8	3.3	3.7	4.2	4.7	5.1	52.0
52.5	3.0	3.1	3.2	3.4	3.6	3.7	3.8	3.9	4.1	4.2	4.4	4.6	4.7	2.5	2.9	3.4	3.8	4.3	4.8	5.3	52.5
53.0	3.0	3.1	3.3	3.5	3.6	3.8	3.9	4.0	4.2	4.3	4.5	4.7	4.9	2.5	3.0	3.4	3.9	4.4	4.9	5.4	53.0
53.5	3.1	3.2	3.4	3.6	3.7	3.9	4.0	4.1	4.3	4.4	4.7	4.9	5.0	2.6	3.1	3.5	4.0	4.5	5.0	5.6	53.5
54.0	3.2	3.3	3.5	3.7	3.8	4.0	4.1	4.2	4.4	4.5	4.8	5.0	5.1	2.7	3.1	3.6	4.1	4.6	5.2	5.7	54.0
54.5	3.3	3.4	3.6	3.8	3.9	4.1	4.2	4.3	4.5	4.7	4.9	5.1	5.2	2.7	3.2	3.7	4.2	4.7	5.3	5.9	54.5
55.0	3.4	3.5	3.7	3.9	4.0	4.2	4.3	4.4	4.6	4.8	5.0	5.2	5.4	2.8	3.3	3.8	4.3	4.9	5.5	6.0	55.0
55.5	3.4	3.6	3.7	4.0	4.1	4.3	4.4	4.6	4.7	4.9	5.2	5.4	5.5	2.9	3.4	3.9	4.4	5.0	5.6	6.2	55.5
56.0	3.5	3.7	3.8	4.1	4.2	4.4	4.5	4.7	4.8	5.0	5.3	5.5	5.7	3.0	3.5	4.0	4.5	5.1	5.7	6.3	56.0
56.5	3.6	3.8	4.0	4.2	4.4	4.5	4.6	4.8	5.0	5.2	5.4	5.7	5.8	3.0	3.6	4.1	4.6	5.3	5.9	6.5	56.5
57.0	3.7	3.9	4.1	4.3	4.5	4.6	4.8	4.9	5.1	5.3	5.6	5.8	5.9	3.1	3.7	4.2	4.8	5.4	6.0	6.6	57.0
57.5	3.8	4.0	4.2	4.4	4.6	4.7	4.9	5.0	5.2	5.4	5.7	5.9	6.1	3.2	3.8	4.3	4.9	5.5	6.2	6.8	57.5
58.0	3.9	4.1	4.3	4.5	4.7	4.9	5.0	5.2	5.4	5.6	5.8	6.1	6.2	3.3	3.9	4.4	5.0	5.7	6.3	7.0	58.0
58.5	4.1	4.2	4.4	4.7	4.8	5.0	5.1	5.3	5.5	5.7	6.0	6.2	6.4	3.4	4.0	4.6	5.1	5.8	6.5	7.1	58.5
59.0	4.2	4.3	4.5	4.8	5.0	5.1	5.3	5.4	5.6	5.8	6.1	6.4	6.5	3.5	4.1	4.7	5.3	5.9	6.6	7.3	59.0
59.5	4.3	4.4	4.6	4.9	5.1	5.3	5.4	5.6	5.8	6.0	6.3	6.5	6.7	3.6	4.2	4.8	4.4	6.1	6.8	7.4	59.5
60.0	4.4	4.5	4.8	5.0	5.2	5.4	5.5	5.7	5.9	6.1	6.4	6.7	6.8	3.7	4.3	4.9	5.5	6.2	6.9	7.6	60.0
60.5	4.5	4.7	4.9	5.2	5.4	5.5	5.7	5.9	6.0	6.3	6.6	6.8	7.0	3.8	4.4	5.1	5.7	6.4	7.1	7.7	60.5

TABLE 11—*Continued*

Length	Centiles													Standard deviations							Length
cm	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	cm
61.0	4.6	4.8	5.0	5.3	5.5	5.7	5.8	6.0	6.2	6.4	6.7	7.0	7.1	3.9	4.6	5.2	5.8	6.5	7.2	7.9	61.0
61.5	4.7	4.9	5.1	5.4	5.6	5.8	6.0	6.1	6.3	6.6	6.9	7.1	7.3	4.0	4.7	5.3	6.0	6.7	7.4	8.1	61.5
62.0	4.9	5.0	5.3	5.6	5.8	5.9	6.1	6.3	6.5	6.7	7.0	7.3	7.4	4.1	4.8	5.4	6.1	6.8	7.5	8.2	62.0
62.5	5.0	5.2	5.4	5.7	5.9	6.1	6.2	6.4	6.6	6.8	7.2	7.4	7.6	4.2	4.9	5.6	6.2	7.0	7.7	8.4	62.5
63.0	5.1	5.3	5.5	5.8	6.0	6.2	6.4	6.6	6.8	7.0	7.3	7.6	7.7	4.4	5.0	5.7	6.4	7.1	7.8	8.5	63.0
63.5	5.2	5.4	5.7	6.0	6.2	6.4	6.5	6.7	6.9	7.1	7.5	7.7	7.9	4.5	5.2	5.8	6.5	7.3	8.0	8.7	63.5
64.0	5.4	5.5	5.8	6.1	6.3	6.5	6.7	6.9	7.1	7.3	7.6	7.9	8.0	4.6	5.3	6.0	6.7	7.4	8.1	8.9	64.0
64.5	5.5	5.7	5.9	6.2	6.5	6.6	6.8	7.0	7.2	7.4	7.8	8.0	8.2	4.7	5.4	6.1	6.8	7.6	8.3	9.0	64.5
65.0	5.6	5.8	6.1	6.4	6.6	6.8	7.0	7.2	7.4	7.6	7.9	8.2	8.4	4.8	5.5	6.3	7.0	7.7	8.4	9.2	65.0
65.5	5.8	5.9	6.2	6.5	6.7	6.9	7.1	7.3	7.5	7.7	8.1	8.3	8.5	4.9	5.7	6.4	7.1	7.9	8.6	9.3	65.5
66.0	5.9	6.1	6.3	6.6	6.9	7.1	7.3	7.4	7.6	7.9	8.2	8.5	8.7	5.1	5.8	6.5	7.3	8.0	8.7	9.5	66.0
66.5	6.0	6.2	6.5	6.8	7.0	7.2	7.4	7.6	7.8	8.0	8.4	8.6	8.8	5.2	5.9	6.7	7.4	8.1	8.9	9.6	66.5
67.0	6.1	6.3	6.6	6.9	7.2	7.4	7.5	7.7	7.9	8.2	8.5	8.8	9.0	5.3	6.0	6.8	7.5	8.3	9.0	9.8	67.0
67.5	6.3	6.4	6.7	7.0	7.3	7.5	7.7	7.9	8.1	8.3	8.7	8.9	9.1	5.4	6.2	6.9	7.7	8.4	9.2	9.9	67.5
68.0	6.4	6.6	6.8	7.2	7.4	7.6	7.8	8.0	8.2	8.5	8.8	9.1	9.2	5.5	6.3	7.1	7.8	8.6	9.3	10.1	68.0
68.5	6.5	6.7	7.0	7.3	7.6	7.8	8.0	8.2	8.4	8.6	8.9	9.2	9.4	5.6	6.4	7.2	8.0	8.7	9.5	10.2	68.5
69.0	6.6	6.8	7.1	7.4	7.7	7.9	8.1	8.3	8.5	8.7	9.1	9.4	9.5	5.8	6.5	7.3	8.1	8.9	9.6	10.4	69.0
69.5	6.8	6.9	7.2	7.6	7.8	8.0	8.2	8.4	8.6	8.9	9.2	9.5	9.7	5.9	6.7	7.5	8.2	9.0	9.8	10.5	69.5
70.0	6.9	7.1	7.4	7.7	8.0	8.2	8.4	8.6	8.8	9.0	9.4	9.6	9.8	6.0	6.8	7.6	8.4	9.1	9.9	10.7	70.0
70.5	7.0	7.2	7.5	7.8	8.1	8.3	8.5	8.7	8.9	9.2	9.5	9.8	10.0	6.1	6.9	7.7	8.5	9.3	10.1	10.8	70.5
71.0	7.1	7.3	7.6	8.0	8.2	8.4	8.6	8.8	9.0	9.3	9.6	9.9	10.1	6.2	7.0	7.8	8.6	9.4	10.2	11.0	71.0
71.5	7.2	7.4	7.7	8.1	8.3	8.6	8.8	9.0	9.2	9.4	9.8	10.0	10.2	6.3	7.1	8.0	8.8	9.5	10.3	11.1	71.5
72.0	7.3	7.5	7.8	8.2	8.5	8.7	8.9	9.1	9.3	9.6	9.9	10.2	10.4	6.4	7.2	8.1	8.9	9.7	10.5	11.2	72.0
72.5	7.5	7.7	8.0	8.3	8.6	8.8	9.0	9.2	9.4	9.7	10.0	10.3	10.5	6.5	7.4	8.2	9.0	9.8	10.6	11.4	72.5

TABLE 11—*Continued*

Length cm	Centiles												Standard deviations							Length cm
	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	
73.0	7.6	7.8	8.1	8.4	8.7	8.9	9.1	9.3	9.6	9.8	10.1	10.4	10.6	6.6	7.5	8.3	9.1	9.9	10.7	11.5	73.0
73.5	7.7	7.9	8.2	8.5	8.8	9.0	9.3	9.5	9.7	9.9	10.3	10.6	10.7	6.7	7.6	8.4	9.3	10.0	10.8	11.6	73.5
74.0	7.8	8.0	8.3	8.7	8.9	9.2	9.4	9.6	9.8	10.0	10.4	10.7	10.9	6.8	7.7	8.5	9.4	10.2	11.0	11.8	74.0
74.5	7.9	8.1	8.4	8.8	9.0	9.3	9.5	9.7	9.9	10.2	10.5	10.8	11.0	6.9	7.8	8.6	9.5	10.3	11.1	11.9	74.5
75.0	8.0	8.2	8.5	8.9	9.1	9.4	9.6	9.8	10.0	10.3	10.6	10.9	11.1	7.0	7.9	8.7	9.6	10.4	11.2	12.0	75.0
75.5	8.1	8.3	8.6	9.0	9.3	9.5	9.7	9.9	10.1	10.4	10.7	11.0	11.2	7.1	8.0	8.8	9.7	10.5	11.3	12.1	75.5
76.0	8.2	8.4	8.7	9.1	9.4	9.6	9.8	10.0	10.2	10.5	10.9	11.2	11.3	7.2	8.1	8.9	9.8	10.6	11.4	12.3	76.0
76.5	8.3	8.5	8.8	9.2	9.5	9.7	9.9	10.1	10.3	10.6	11.0	11.3	11.5	7.3	8.2	9.0	9.9	10.7	11.6	12.4	76.5
77.0	8.4	8.6	8.9	9.3	9.6	9.8	10.0	10.2	10.5	10.7	11.1	11.4	11.6	7.4	8.3	9.1	10.0	10.8	11.7	12.5	77.0
77.5	8.5	8.7	9.0	9.4	9.7	9.9	10.1	10.3	10.6	10.8	11.2	11.5	11.7	7.5	8.4	9.2	10.1	11.0	11.8	12.6	77.5
78.0	8.6	8.8	9.1	9.5	9.8	10.0	10.2	10.4	10.7	10.9	11.3	11.6	11.8	7.6	8.5	9.3	10.2	11.1	11.9	12.7	78.0
78.5	8.7	8.9	9.2	9.6	9.9	10.1	10.3	10.5	10.8	11.0	11.4	11.7	11.9	7.7	8.6	9.4	10.3	11.2	12.0	12.9	78.5
79.0	8.8	9.0	9.3	9.7	10.0	10.2	10.4	10.6	10.9	11.1	11.5	11.8	12.0	7.8	8.7	9.5	10.4	11.3	12.1	13.0	79.0
79.5	8.9	9.1	9.4	9.8	10.1	10.3	10.5	10.7	11.0	11.2	11.6	11.9	12.1	7.9	8.7	9.6	10.5	11.4	12.2	13.1	79.5
80.0	8.9	9.2	9.5	9.9	10.1	10.4	10.6	10.8	11.1	11.3	11.7	12.0	12.2	8.0	8.8	9.7	10.6	11.5	12.3	13.2	80.0
80.5	9.0	9.2	9.6	10.0	10.2	10.5	10.7	10.9	11.2	11.4	11.8	12.1	12.3	8.0	8.9	9.8	10.7	11.6	12.4	13.3	80.5
81.0	9.1	9.3	9.7	10.1	10.3	10.6	10.8	11.0	11.3	11.5	11.9	12.2	12.4	8.1	9.0	9.9	10.8	11.7	12.6	13.4	81.0
81.5	9.2	9.4	9.8	10.1	10.4	10.7	10.9	11.1	11.4	11.6	12.0	12.3	12.6	8.2	9.1	10.0	10.9	11.8	12.7	13.5	81.5
82.0	9.3	9.5	9.8	10.2	10.5	10.8	11.0	11.2	11.5	11.7	12.1	12.5	12.7	8.3	9.2	10.1	11.0	11.9	12.8	13.7	82.0
82.5	9.4	9.6	9.9	10.3	10.6	10.9	11.1	11.3	11.6	11.8	12.2	12.6	12.8	8.4	9.3	10.2	11.1	12.0	12.9	13.8	82.5
83.0	9.5	9.7	10.0	10.4	10.7	10.9	11.2	11.4	11.7	11.9	12.3	12.7	12.9	8.5	9.4	10.3	11.2	12.1	13.0	13.9	83.0
83.5	9.6	9.8	10.1	10.5	10.8	11.0	11.3	11.5	11.7	12.0	12.4	12.8	13.0	8.6	9.5	10.4	11.3	12.2	13.1	14.0	83.5
84.0	9.7	9.9	10.2	10.6	10.9	11.1	11.4	11.6	11.8	12.1	12.5	12.9	13.1	8.7	9.6	10.5	11.4	12.3	13.2	14.1	84.0
84.5	9.8	10.0	10.3	10.7	11.0	11.2	11.5	11.7	11.9	12.2	12.6	13.0	13.2	8.7	9.6	10.6	11.5	12.4	13.3	14.2	84.5

TABLE 11—*Continued*

Length cm	Centiles													Standard deviations							Length cm
	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	
85.0	9.8	10.1	10.4	10.8	11.1	11.3	11.6	11.8	12.0	12.3	12.7	13.1	13.3	8.8	9.7	10.6	11.6	12.5	13.4	14.3	85.0
85.5	9.9	10.2	10.5	10.9	11.2	11.4	11.7	11.9	12.1	12.4	12.9	13.2	13.4	8.9	9.8	10.7	11.7	12.6	13.5	14.5	85.5
86.0	10.0	10.2	10.6	11.0	11.3	11.5	11.8	12.0	12.2	12.5	13.0	13.3	13.5	9.0	9.9	10.8	11.8	12.7	13.6	14.6	86.0
86.5	10.1	10.3	10.7	11.1	11.4	11.6	11.8	12.1	12.3	12.6	13.1	13.4	13.6	9.1	10.0	10.9	11.8	12.8	13.7	14.7	86.5
87.0	10.2	10.4	10.8	11.2	11.5	11.7	11.9	12.2	12.4	12.8	13.2	13.5	13.7	9.2	10.1	11.0	11.9	12.9	13.9	14.8	87.0
87.5	10.3	10.5	10.9	11.3	11.6	11.8	12.0	12.3	12.6	12.9	13.3	13.6	13.9	9.3	10.2	11.1	12.0	13.0	14.0	14.9	87.5
88.0	10.4	10.6	11.0	11.4	11.7	11.9	12.2	12.4	12.7	13.0	13.4	13.7	14.0	9.4	10.3	11.2	12.2	13.1	14.1	15.0	88.0
88.5	10.5	10.7	11.1	11.5	11.8	12.0	12.3	12.5	12.8	13.1	13.5	13.8	14.1	9.4	10.4	11.3	12.3	13.2	14.2	15.2	88.5
89.0	10.6	10.8	11.2	11.6	11.9	12.1	12.4	12.6	12.9	13.2	13.6	14.0	14.2	9.5	10.5	11.4	12.4	13.3	14.3	15.3	89.0
89.5	10.7	10.9	11.3	11.7	12.0	12.2	12.5	12.7	13.0	13.3	13.7	14.1	14.3	9.6	10.6	11.5	12.5	13.4	14.4	15.4	89.5
90.0	10.8	11.0	11.4	11.8	12.1	12.3	12.6	12.8	13.1	13.4	13.8	14.2	14.4	9.7	10.7	11.6	12.6	13.6	14.5	15.5	90.0
90.5	10.9	11.1	11.5	11.9	12.2	12.4	12.7	12.9	13.2	13.5	14.0	14.3	14.5	9.8	10.8	11.7	12.7	13.7	14.7	15.7	90.5
91.0	11.0	11.2	11.6	12.0	12.3	12.6	12.8	13.1	13.3	13.6	14.1	14.4	14.7	9.9	10.9	11.8	12.8	13.8	14.8	15.8	91.0
91.5	11.1	11.3	11.7	12.1	12.4	12.7	12.9	13.2	13.4	13.8	14.2	14.6	14.8	10.0	11.0	11.9	12.9	13.9	14.9	15.9	91.5
92.0	11.2	11.4	11.8	12.2	12.5	12.8	13.0	13.3	13.6	13.9	14.3	14.7	14.9	10.1	11.1	12.1	13.0	14.0	15.0	16.0	92.0
92.5	11.3	11.5	11.9	12.3	12.6	12.9	13.1	13.4	13.7	14.0	14.4	14.8	15.1	10.2	11.2	12.2	13.1	14.2	15.2	16.2	92.5
93.0	11.4	11.7	12.0	12.4	12.8	13.0	13.3	13.5	13.8	14.1	14.6	14.9	15.2	10.3	11.3	12.3	13.3	14.3	15.3	16.3	93.0
93.5	11.5	11.8	12.1	12.6	12.9	13.1	13.4	13.7	13.9	14.3	14.7	15.1	15.3	10.4	11.4	12.4	13.4	14.4	15.4	16.5	93.5
94.0	11.6	11.9	12.2	12.7	13.0	13.3	13.5	13.8	14.1	14.4	14.8	15.2	15.5	10.5	11.5	12.5	13.5	14.5	15.6	16.6	94.0
94.5	11.8	12.0	12.4	12.8	13.1	13.4	13.6	13.9	14.2	14.5	15.0	15.3	15.6	10.6	11.6	12.6	13.6	14.7	15.7	16.7	94.5
95.0	11.9	12.1	12.5	12.9	13.2	13.5	13.8	14.0	14.3	14.6	15.1	15.5	15.7	10.7	11.8	12.8	13.8	14.8	15.9	16.9	95.0
95.5	12.0	12.2	12.6	13.0	13.4	13.6	13.9	14.2	14.5	14.8	15.2	15.6	15.9	10.9	11.9	12.9	13.9	15.0	16.0	17.0	95.5
96.0	12.1	12.4	12.7	13.2	13.5	13.8	14.0	14.3	14.6	14.9	15.4	15.8	16.0	11.0	12.0	13.0	14.0	15.1	16.1	17.2	96.0
96.5	12.2	12.5	12.9	13.3	13.6	13.9	14.2	14.4	14.7	15.1	15.5	15.9	16.2	11.1	12.1	13.1	14.2	15.2	16.3	17.4	96.5

TABLE 11—*Continued*

Stature cm	Centiles													Standard deviations							Stature cm
	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	
97.0	12.4	12.6	13.0	13.4	13.8	14.0	14.3	14.6	14.9	15.2	15.7	16.1	16.3	11.2	12.2	13.3	14.3	15.4	16.5	17.5	97.0
97.5	12.5	12.7	13.1	13.6	13.9	14.2	14.4	14.7	15.0	15.4	15.8	16.2	16.5	11.3	12.4	13.4	14.4	15.5	16.6	17.7	97.5
98.0	12.6	12.9	13.3	13.7	14.0	14.3	14.6	14.9	15.2	15.5	16.0	16.4	16.6	11.5	12.5	13.5	14.6	15.7	16.8	17.9	98.0
98.5	12.8	13.0	13.4	13.8	14.2	14.5	14.7	15.0	15.3	15.7	16.1	16.5	16.8	11.6	12.6	13.7	14.7	15.8	16.9	18.0	98.5
99.0	12.9	13.1	13.5	14.0	14.3	14.6	14.9	15.2	15.5	15.8	16.3	16.7	17.0	11.7	12.8	13.8	14.9	16.0	17.1	18.2	99.0
99.5	13.0	13.3	13.7	14.1	14.5	14.7	15.0	15.3	15.6	16.0	16.5	16.9	17.1	11.9	12.9	14.0	15.0	16.1	17.3	18.4	99.5
100.0	13.2	13.4	13.8	14.3	14.6	14.9	15.2	15.5	15.8	16.1	16.6	17.0	17.3	12.0	13.1	14.1	15.2	16.3	17.4	18.6	100.0
100.5	13.3	13.6	14.0	14.4	14.8	15.0	15.3	15.6	15.9	16.3	16.8	17.2	17.5	12.1	13.2	14.3	15.3	16.5	17.6	18.8	100.5
101.0	13.5	13.7	14.1	14.6	14.9	15.2	15.5	15.8	16.1	16.4	17.0	17.4	17.7	12.3	13.3	14.4	15.5	16.6	17.8	19.0	101.0

TABLE 2

Standards for Male Arm Muscle Circumference

Age Group	*Arm Muscle Circumference (mm)*						
	5	*10*	*25*	*50*	*75*	*90*	*95*
1– 1.9	110	113	119	127	135	144	147
2– 2.9	111	114	122	130	140	146	150
3– 3.9	117	123	131	137	143	148	153
4– 4.9	123	126	133	141	148	156	159
5– 5.9	128	133	140	147	154	162	169
6– 6.9	131	135	142	151	161	170	177
7– 7.9	137	139	151	160	168	177	190
8– 8.9	140	145	154	162	170	182	187
9– 9.9	151	154	161	170	183	196	202
10–10.9	156	160	166	180	191	209	221
11–11.9	159	165	173	183	195	205	230
12–12.9	167	171	182	195	210	223	241
13–13.9	172	179	196	211	226	238	245
14–14.9	189	199	212	223	240	260	264
15–15.9	199	204	218	237	254	266	272
16–16.9	213	225	234	249	269	287	296
17–17.9	224	231	245	258	273	294	312
18–18.9	226	237	252	264	283	298	324
19–24.9	238	245	257	273	289	309	321
25–34.9	243	250	264	279	298	314	326
35–44.9	247	255	269	286	302	318	327
45–54.9	239	249	265	281	300	315	326
55–64.9	236	245	260	278	295	310	320
65–74.9	223	235	251	268	284	298	306

Standards for Female Arm Muscle Circumference

Age Group	*Arm Muscle Circumference (mm)*						
	5	*10*	*25*	*50*	*75*	*90*	*95*
1– 1.9	105	111	117	124	132	139	143
2– 2.9	111	114	119	126	133	142	147
3– 3.9	113	119	124	132	140	146	152
4– 4.9	115	121	128	136	144	152	157
5– 5.9	125	128	134	142	151	159	165
6– 6.9	130	133	138	145	154	166	171
7– 7.9	129	135	142	151	160	171	176
8– 8.9	138	140	151	160	171	183	194
9– 9.9	147	150	158	167	180	194	198
10–10.9	148	150	159	170	180	190	197
11–11.9	150	158	171	181	196	217	223
12–12.9	162	166	180	191	201	214	220
13–13.9	169	175	183	198	211	226	240
14–14.9	174	179	190	201	216	232	247
15–15.9	175	178	189	202	215	228	244
16–16.9	170	180	190	202	216	234	249
17–17.9	175	183	194	205	221	239	257
18–18.9	174	179	191	202	215	237	245
19–24.9	179	185	195	207	221	236	249
25–34.9	183	188	199	212	228	246	264
35–44.9	186	192	205	218	236	257	272
45–54.9	187	193	206	220	238	260	274
55–64.9	187	196	209	225	244	266	280
65–74.9	185	195	208	225	244	264	279

TABLE 12—*Continued*

Stature	Centiles													Standard deviations							Stature
cm	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	cm
67.0	6.1	6.3	6.7	7.1	7.4	7.7	7.9	8.2	8.6	8.9	9.5	9.9	10.2	5.0	5.9	6.9	7.9	9.1	10.4	11.6	67.0
67.5	6.2	6.4	6.8	7.2	7.5	7.8	8.0	8.4	8.7	9.1	9.6	10.1	10.4	5.1	6.1	7.0	8.0	9.3	10.5	11.7	67.5
68.0	6.3	6.5	6.9	7.3	7.6	7.9	8.2	8.5	8.8	9.2	9.7	10.2	10.5	5.2	6.2	7.2	8.2	9.4	10.6	11.9	68.0
68.5	6.4	6.6	7.0	7.4	7.8	8.0	8.3	8.6	8.9	9.3	9.9	10.3	10.6	5.3	6.3	7.3	8.3	9.5	10.7	12.0	68.5
69.0	6.5.	6.8	7.1	7.6	7.9	8.1	8.4	8.7	9.1	9.4	10.0	10.4	10.7	5.4	6.4	7.4	8.4	9.6	10.9	12.1	69.0
69.5	6.6	6.9	7.2	7.7	8.0	8.3	8.5	8.8	9.2	9.6	10.1	10.6	10.8	5.5	6.5	7.5	8.5	9.8	11.0	12.2	69.5
70.0	6.7	7.0	7.3	7.8	8.1	8.4	8.6	9.0	9.3	9.7	10.2	10.7	11.0	5.6	6.6	7.6	8.6	9.9	11.1	12.4	70.0
70.5	6.8	7.1	7.5	7.9	8.2	8.5	8.8	9.1	9.4	9.8	10.3	10.8	11.1	5.7	6.7	7.7	8.8	10.0	11.2	12.5	70.5
71.0	7.0	7.2	7.6	8.0	8.3	8.6	8.9	9.2	9.5	9.9	10.5	10.9	11.2	5.8	6.8	7.9	8.9	10.1	11.4	12.6	71.0
71.5	7.1	7.3	7.7	8.1	8.4	8.7	9.0	9.3	9.6	10.0	10.6	11.0	11.3	5.9	6.9	8.0	9.0	10.2	11.5	12.7	71.5
72.0	7.2	7.4	7.8	8.2	8.6	8.8	9.1	9.4	9.7	10.1	10.7	11.1	11.4	6.0	7.1	8.1	9.1	10.3	11.6	12.8	72.0
72.5	7.3	7.5	7.9	8.3	8.7	8.9	9.2	9.5	9.9	10.3	10.8	11.3	11.6	6.1	7.2	8.2	9.2	10.5	11.7	13.0	72.5
73.0	7.4	7.6	8.0	8.5	8.8	9.1	9.3	9.6	10.0	10.4	10.9	11.4	11.7	6.2	7.3	8.3	9.3	10.6	11.8	13.1	73.0
73.5	7.5	7.7	8.1	8.6	8.9	9.2	9.4	9.7	10.1	10.5	11.0	11.5	11.8	6.4	7.4	8.4	9.4	10.7	11.9	13.2	73.5
74.0	7.6	7.8	8.2	8.7	9.0	9.3	9.5	9.9	10.2	10.6	11.1	11.6	11.9	6.5	7.5	8.5	9.5	10.8	12.1	13.3	74.0
74.5	7.7	8.0	8.3	8.8	9.1	9.4	9.6	10.0	10.3	10.7	11.3	11.7	12.0	6.6	7.6	8.6	9.6	10.9	12.2	13.4	74.5
75.0	7.8	8.1	8.4	8.9	9.2	9.5	9.7	10.1	10.4	10.8	11.4	11.8	12.1	6.7	7.7	8.7	9.7	11.0	12.3	13.6	75.0
75.5	7.9	8.2	8.5	9.0	9.3	9.6	9.9	10.2	10.5	10.9	11.5	11.9	12.2	6.8	7.8	8.8	9.9	11.1	12.4	13.7	75.5
76.0	8.0	8.3	8.6	9.1	9.4	9.7	10.0	10.3	10.6	11.0	11.6	12.1	12.4	6.9	7.9	8.9	10.0	11.2	12.5	13.8	76.0
76.5	8.1	8.4	8.7	9.2	9.5	9.8	10.1	10.4	10.7	11.1	11.7	12.2	12.5	7.0	8.0	9.0	10.1	11.3	12.6	13.9	76.5
77.0	8.2	8.5	8.8	9.3	9.6	9.9	10.2	10,5	10.8	11.2	11.8	12.3	12.6	7.1	8.1	9.1	10.2	11.5	12.7	14.0	77.0
77.5	8.3	8.6	8.9	9.4	9.7	10.0	10.3	10.6	10.9	11.4	11.9	12.4	12.7	7.2	8.2	9.2	10.3	11.6	12.8	14.1	77.5
78.0	8.4	8.7	9.1	9.5	9.8	10.1	10.4	10.7	11.1	11.5	12.0	12.5	12.8	7.3	8.3	9.3	10.4	11.7	13.0	14.3	78.0
78.5	8.5	8.8	9.2	9.6	9.9	10.2	10.5	10.8	11.2	11.6	12.1	12.6	12.9	7.4	8.4	9.4	10.5	11.8	13.1	14.4	78.5

TABLE 12—*Continued*

Stature cm	Centiles													Standard deviations							Stature cm
	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	
79.0	8.6	8.9	9.3	9.7	10.0	10.3	10.6	10.9	11.3	11.7	12.3	12.7	13.0	7.5	8.5	9.5	10.6	11.9	13.2	14.5	79.0
79.5	8.7	9.0	9.4	9.8	10.1	10.4	10.7	11.0	11.4	11.8	12.4	12.8	13.1	7.6	8.6	9.7	10.7	12.0	13.3	14.6	79.5
80.0	8.8	9.1	9.5	9.9	10.2	10.5	10.8	11.1	11.5	11.9	12.5	12.9	13.3	7.7	8.7	9.8	10.8	12.1	13.4	14.7	80.0
80.5	8.9	9.2	9.6	10.0	10.3	10.6	10.9	11.2	11.6	12.0	12.6	13.1	13.4	7.8	8.8	9.9	10.9	12.2	13.5	14.8	80.5
81.0	9.0	9.3	9.7	10.1	10.5	10.7	11.0	11.3	11.7	12.1	12.7	13.2	13.5	7.9	8.9	10.0	11.0	12.3	13.6	15.0	81.0
81.5	9.1	9.4	9.8	10.2	10.6	10.8	11.1	11.4	11.8	12.2	12.8	13.3	13.6	8.0	9.0	10.1	11.1	12.4	13.8	15.1	81.5
82.0	9.2	9.5	9.9	10.3	10.7	10.9	11.2	11.5	11.9	12.3	12.9	13.4	13.7	8.1	9.1	10.2	11.2	12.5	13.9	15.2	82.0
82.5	9.3	9.6	10.0	10.4	11.8	11.0	11.3	11.6	12.0	12.4	13.0	13.5	13.8	8.2	9.2	10.3	11.3	12.6	14.0	15.3	82.5
83.0	9.4	9.7	10.1	10.5	10.9	11.1	11.4	11.8	12.1	12.5	13.1	13.6	13.9	8.3	9.3	10.4	11.4	12.8	14.1	15.4	83.0
83.5	9.5	9.8	10.2	10.6	11.0	11.2	11.5	11.9	12.2	12.7	13.2	13.7	14.1	8.3	9.4	10.5	11.5	12.9	14.2	15.6	83.5
84.0	9.6	9.9	10.3	10.7	11.1	11.4	11.6	12.0	12.3	12.8	13.4	13.8	14.2	8.4	9.5	10.6	11.6	13.0	14.3	15.7	84.0
84.5	9.7	10.0	10.4	10.8	11.2	11.5	11.7	12.1	12.4	12.9	13.5	14.0	14.3	8.5	9.6	10.7	11.7	13.1	14.4	15.8	84.5
85.0	9.8	10.1	10.5	10.9	11.3	11.6	11.8	12.2	12.6	13.0	13.6	14.1	14.4	8.6	9.7	10.8	11.8	13.2	14.6	15.9	85.0
85.5	9.9	10.2	10.6	11.0	11.4	11.7	11.9	12.3	12.7	13.1	13.7	14.2	14.5	8.7	9.8	10.9	11.9	13.3	14.7	16.1	85.5
86.0	10.0	10.3	10.7	11.1	11.5	11.8	12.0	12.4	12.8	13.2	13.8	14.3	14.6	8.8	9.9	11.0	12.0	13.4	14.8	16.2	86.0
86.5	10.1	10.4	10.8	11.2	11.6	11.9	12.2	12.5	12.9	13.3	13.9	14.4	14.8	8.9	10.0	11.1	12.2	13.5	14.9	11.3	86.5
87.0	10.2	10.5	10.9	11.3	11.7	12.0	12.3	12.6	13.0	13.4	14.1	14.6	14.9	9.0	10.1	11.2	12.3	13.7	15.1	16.4	87.0
87.5	10.3	10.6	11.0	11.4	11.8	12.1	12.4	12.7	13.1	13.6	14.2	14.7	15.0	9.1	10.2	11.3	12.4	13.8	15.2	16.6	87.5
88.0	10.4	10.7	11.1	11.6	11.9	12.2	12.5	12.8	13.2	13.7	14.3	14.8	15.1	9.2	10.3	11.4	12.5	13.9	15.3	16.7	88.0
88.5	10.5	10.8	11.2	11.7	12.0	12.3	12.6	13.0	13.3	13.8	14.4	14.9	15.3	9.3	10.4	11.5	12.6	14.0	15.4	16.8	88.5
89.0	10.6	10.9	11.3	11.8	12.1	12.4	12.7	13.1	13.5	13.9	14.5	15.0	15.4	9.3	10.5	11.6	12.7	14.1	15.6	17.0	89.0
89.5	10.7	10.9	11.4	11.9	12.2	12.5	12.8	13.2	13.6	14.0	14.7	15.2	15.5	9.4	10.6	11.7	12.8	14.2	15.7	17.1	89.5
90.0	10.8	11.1	11.5	12.0	12.3	12.6	12.9	13.3	13.7	14.1	14.8	15.3	15.6	9.5	10.7	11.8	12.9	14.4	15.8	17.3	90.0
90.5	10.9	11.2	11.6	12.1	12.4	12.8	13.0	13.4	13.8	14.3	14.9	15.4	15.8	9.6	10.7	11.9	13.0	14.5	15.9	17.4	90.5

TABLE 12—*Continued*

Stature cm	Centiles													Standard deviations							Stature cm
	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	
91.0	11.0	11.3	11.7	12.2	12.6	12.9	13.2	13.5	13.9	14.4	15.0	15.6	15.9	9.7	10.8	12.0	13.2	14.6	16.1	17.5	91.0
91.5	11.1	11.4	11.8	12.3	12.7	13.0	13.3	13.6	14.0	14.5	15.2	15.7	16.0	9.8	10.9	12.1	13.3	14.7	16.2	17.7	91.5
92.0	11.2	11.5	11.9	12.4	12.8	13.1	13.4	13.8	14.2	14.6	15.3	15.8	16.2	9.9	11.0	12.2	13..4	14.9	16.3	17.8	92.0
92.5	11.3	11.6	12.0	12.5	12.9	13.2	13.5	13.9	14.3	14.8	15.4	15.9	16.3	9.9	11.1	12.3	13.5	15.0	16.5	18.0	92.5
93.0	11.4	11.7	12.1	12.6	13.0	13.3	13.6	14.0	14.4	14.9	15.5	16.1	16.4	10.0	11.2	12.4	13.6	15.1	16.6	18.1	93.0
93.5	11.5	11.8	12.2	12.7	13.1	13.4	13.7	14.1	14.5	15.0	15.7	16.2	16.6	10.1	11.3	12.5	13.7	15.2	16.7	18.3	93.5
94.0	11.6	11.9	12.3	12.8	13.2	13.6	13.9	14.2	14.7	15.1	15.8	16.4	16.7	10.2	11.4	12.6	13.9	15.4	16.9	18.4	94.0
94.5	11.7	12.0	12.4	12.9	13.3	13.7	14.0	14.4	14.8	15.3	15.9	16.5	16.8	10.3	11.5	12.8	14.0	15.5	17.0	18.6	94.5
95.0	11.8	12.1	12.5	13.1	13.5	13.8	14.1	14.5	14.9	15.4	16.1	16.6	17.0	10.4	11.6	12.9	14.1	15.6	17.2	18.7	95.0
95.5	11.9	12.2	12.6	13.2	13.6	13.9	14.2	14.6	15.0	15.5	16.2	16.8	17.1	10.5	11.7	13.0	14.2	15.8	17.3	18.9	95.5
96.0	12.0	12.3	12.7	13.3	13.7	14.0	14.3	14.7	15.2	15.7	16.3	16.9	17.3	10.6	11.8	13.1	14.3	15.9	17.5	19.0	96.0
96.5	12.1	12.4	12.8	13.4	13.8	14.2	14.5	14.9	15.3	15.8	16.5	17.0	17.4	10.7	11.9	13.2	14.5	16.0	17.6	19.2	96.5
97.0	12.2	12.5	13.0	13.5	13.9	14.3	14.6	15.0	15.4	15.9	16.6	17.2	17.6	10.7	12.0	13.3	14.6	16.2	17.8	19.3	97.0
97.5	12.3	12.6	13.1	13.6	14.0	14.4	14.7	15.1	15.6	16.1	16.8	17.3	17.7	10.8	12.1	13.4	14.7	16.3	17.9	19.5	97.5
98.0	12.4	12.7	13.2	13.7	14.2	14.5	14.9	15.3	15.7	16.2	16.9	17.5	17.9	10.9	12.2	13.5	14.9	16.5	18.1	19.7	98.0
98.5	12.5	12.8	13.3	13.9	14.3	14.6	15.0	15.4	15.8	16.3	17.0	17.6	18.0	11.0	12.3	13.7	15.0	16.6	18.2	19.8	98.5
99.0	12.6	12.9	13.4	14.0	14.4	14.8	15.1	15.5	16.0	16.5	17.2	17.8	18.2	11.1	12.4	13.8	15.1	16.7	18.4	20.0	99.0
99.5	12.7	13.0	13.5	14.1	14.5	14.9	15.2	15.7	16.1	16.6	17.3	17.9	18.3	11.2	12.5	13.9	15.2	16.9	18.5	20.1	99.5
100.0	12.8	13.1	13.6	14.2	14.7	15.0	15.4	15.8	16.2	16.8	17.5	18.1	18.5	11.3	12.7	14.0	15.4	17.0	18.7	20.3	100.0
100.5	12.9	13.2	13.7	14.3	14.8	15.2	15.5	15.9	16.4	16.9	17.6	18.2	18.6	11.4	12.8	14.1	15.5	17.2	18.8	20.5	100.5
101.0	13.0	13.4	13.9	14.5	14.9	15.3	15.6	16.1	16.5	17.0	17.8	18.4	18.8	11.5	12.9	14.3	15.6	17.3	19.0	20.7	101.0
101.5	13.1	13.5	14.0	14.6	15.0	15.4	15.8	16.2	16.7	17.2	17.9	18.5	18.9	11.6	13.0	14.4	15.8	17.5	19.1	20.8	101.5
102.0	13.3	13.6	14.1	14.7	15.2	15.5	15.9	16.3	16.8	17.3	18.1	18.7	19.1	11.7	13.1	14.5	15.9	17.6	19.3	21.0	102.0
102.5	13.4	13.7	14.2	14.8	15.3	15.7	16.0	16.5	16.9	17.5	18.2	18.9	19.3	11.8	13.2	14.6	16.0	17.8	19.5	21.2	102.5

TABLE 12—*Continued*

Stature cm	Centiles													Standard deviations							Stature cm
	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	
103.0	13.5	13.8	14.3	15.0	15.4	15.8	16.2	16.6	17.1	17.6	18.4	19.0	19.4	11.9	13.3	14.7	16.2	17.9	19.6	21.4	103.0
103.5	13.6	13.9	14.5	15.1	15.6	16.0	16.3	16.8	17.2	17.8	18.6	19.2	19.6	12.0	13.4	14.9	16.3	18.1	19.8	21.6	103.5
104.0	13.7	14.1	14.6	15.2	15.7	16.1	16.5	16.9	17.4	17.9	18.7	19.4	19.8	12.1	13.5	15.0	16.5	18.2	20.0	21.7	104.0
104.5	13.8	14.2	14.7	15.4	15.8	16.2	16.6	17.0	17.5	18.1	18.9	19.5	19.9	12.2	13.7	15.1	16.6	18.4	20.1	21.9	104.5
105.0	14.0	14.3	14.8	15.5	16.0	16.4	16.7	17.2	17.7	18.2	19.0	19.7	20.1	12.3	13.8	15.3	16.7	18.5	20.3	22.1	105.0
105.5	14.1	14.4	15.0	15.6	16.1	16.5	16.9	17.3	17.8	18.4	19.2	19.9	20.3	12.4	13.9	15.4	16.9	18.7	20.5	22.3	105.5
106.0	14.2	14.6	15.1	15.8	16.2	16.6	17.0	17.5	18.0	18.6	19.4	20.0	20.5	12.5	14.0	15.5	17.0	18.9	20.7	22.5	106.0
106.5	14.3	14.7	15.2	15.9	16.4	16.8	17.2	17.6	18.1	18.7	19.5	20.2	20.6	12.6	14.1	15.7	17.2	19.0	20.9	22.7	106.5
107.0	14.4	14.8	15.4	16.0	16.5	16.9	17.3	17.8	18.3	18.9	19.7	20.4	20.8	12.7	14.3	15.8	17.3	19.2	21.0	22.9	107.0
107.5	14.6	14.9	15.5	16.2	16.7	17.1	17.5	17.9	18.5	19.0	19.9	20.5	21.0	12.8	14.4	15.9	17.5	19.3	21.2	23.1	107.5
108.0	14.7	15.1	15.6	16.3	16.8	17.2	17.6	18.1	18.6	19.2	20.0	20.7	21.2	13.0	14.5	16.1	17.6	19.5	21.4	23.3	108.0
108.5	14.8	15.2	15.8	16.5	17.0	17.4	17.8	18.3	18.8	19.4	20.2	20.9	21.4	13.1	14.6	16.2	17.8	19.7	21.6	23.5	108.5
109.0	15.0	15.3	15.9	16.6	17.1	17.5	17.9	18.4	18.9	19.5	20.4	21.1	21.5	13.2	14.8	16.4	17.9	19.8	21.8	23.7	109.0
109.5	15.1	15.5	16.0	16.7	17.2	17.7	18.1	18.6	19.1	19.7	20.6	21.3	21.7	13.3	14.9	16.5	18.1	20.0	22.0	23.9	109.5
110.0	15.2	15.6	16.2	16.9	17.4	17.8	18.2	18.7	19.3	19.9	20.7	21.5	21.9	13.4	15.0	16.6	18.2	20.2	22.2	24.1	110.0
110.5	15.4	15.7	16.3	17.0	17.5	18.0	18.4	18.9	19.4	20.1	20.9	21.6	22.1	13.6	15.2	16.8	18.4	20.4	22.4	24.3	110.5
111.0	15.5	15.9	16.5	17.2	17.7	18.1	18.6	19.1	19.6	20.2	21.1	21.8	22.3	13.7	15.3	16.9	18.6	20.6	22.6	24.6	111.0
111.5	15.6	16.0	16.6	17.3	17.9	18.3	18.7	19.2	19.8	20.4	21.3	22.0	22.5	13.8	15.5	17.1	18.7	20.7	22.8	24.8	111.5
112.0	15.8	16.2	16.8	17.5	18.0	18.5	18.9	19.4	19.9	20.6	21.5	22.2	22.7	14.0	15.6	17.2	18.9	20.9	23.0	25.0	112.0
112.5	15.9	16.3	16.9	17.7	18.2	18.6	19.0	19.6	20.1	20.8	21.7	22.4	22.9	14.1	15.7	17.4	19.0	21.1	23.2	25.2	112.5
113.0	16.1	16.5	17.1	17.8	18.3	18.8	19.2	19.7	20.3	21.0	21.9	22.6	23.1	14.2	15.9	17.5	19.2	21.3	23.4	25.5	113.0
113.5	16.2	16.6	17.2	18.0	18.5	19.0	19.4	19.9	20.5	21.2	22.1	22.9	23.4	14.4	16.0	17.7	19.4	21.5	23.6	25.7	113.5
114.0	16.4	16.8	17.4	18.1	18.7	19.1	19.5	20.1	20.7	21.4	22.3	23.1	23.6	14.5	16.2	17.9	19.5	21.7	23.8	26.0	114.0
114.5	16.5	16.9	17.5	18.3	18.8	19.3	19.7	20.3	20.9	21.5	22.5	23.3	23.8	14.6	16.3	18.0	19.7	21.9	24.1	26.2	114.5

TABLE 12—*Continued*

Stature cm	Centiles													Standard deviations							Stature cm
	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	
115.0	16.7	17.1	17.7	18.5	19.0	19.5	19.9	20.5	21.1	21.7	22.7	23.5	24.0	14.8	16.5	18.2	19.9	22.1	24.3	26.5	115.0
115.5	16.8	17.2	17.9	18.6	19.2	19.6	20.1	20.6	21.2	22.0	22.9	23.7	24.3	14.9	16.6	18.4	20.1	22.3	24.5	26.8	115.5
116.0	17.0	17.4	18.0	18.8	19.3	19.8	20.3	20.8	21.4	22.2	23.2	24.0	24.5	15.0	16.8	18.5	20.3	22.5	24.8	27.0	116.0
116.5	17.1	17.6	18.2	19.0	19.5	20.0	20.4	21.0	21.6	22.4	23.4	24.2	24.8	15.2	16.9	18.7	20.4	22.7	25.0	27.3	116.5
117.0	17.3	17.7	18.4	19.1	19.7	20.2	20.6	21.2	21.9	22.6	23.6	24.5	25.0	15.3	17.1	18.9	20.6	23.0	25.3	27.6	117.0
117.5	17.5	17.9	18.5	19.3	19.9	20.4	20.8	21.4	22.1	22.8	23.9	24.7	25.3	15.5	17.3	19.0	20.8	23.2	25.6	27.9	117.5
118.0	17.6	18.1	18.7	19.5	20.1	20.6	21.0	21.6	22.3	23.0	24.1	25.0	25.5	15.6	17.4	19.2	21.0	23.4	25.8	28.2	118.0
118.5	17.8	18.2	18.9	19.7	20.3	20.8	21.2	21.8	22.5	23.3	24.3	25.2	25.8	15.8	17.6	19.4	21.2	23.7	26.1	28.5	118.5
119.0	18.0	18.4	19.1	19.9	20.5	20.9	21.4	22.0	22.7	23.5	24.6	25.5	26.1	15.9	17.7	19.6	21.4	23.9	26.4	28.9	119.0
119.5	18.1	18.6	19.2	20.1	20.6	21.1	21.6	22.3	22.9	23.7	24.9	25.8	26.4	16.1	17.9	19.8	21.6	24.1	26.7	29.2	119.5
120.0	18.3	18.7	19.4	20.2	20.8	21.3	21.8	22.5	23.2	24.0	25.1	26.1	26.7	16.2	18.1	20.0	21.8	24.4	27.0	29.6	120.0
120.5	18.5	18.9	19.6	20.4	21.0	21.6	22.0	22.7	23.4	24.2	25.4	26.4	27.0	16.4	18.3	20.1	22.0	24.7	27.3	29.9	120.5
121.0	18.6	19.1	19.8	20.6	21.2	21.8	22.2	22.9	23.7	24.5	25.7	26.7	27.3	16.5	18.4	20.3	22.2	24.9	27.6	30.3	121.0
121.5	18.8	19.3	20.0	20.8	21.5	22.0	22.5	23.2	23.9	24.8	26.0	27.0	27.6	16.7	18.6	20.5	22.5	25.2	27.9	30.7	121.5
122.0	19.0	19.5	20.2	21.0	21.7	22.2	22.7	23.4	24.1	25.0	26.3	27.3	27.9	16.8	18.8	20.7	22.7	25.5	28.3	31.1	122.0
122.5	19.2	19.7	20.4	21.2	21.9	22.4	22.9	23.6	24.4	25.3	26.6	27.6	28.3	17.0	19.0	20.9	22.9	25.8	28.6	31.5	122.5
123.0	19.4	19.8	20.6	21.5	22.1	22.6	23.1	23.9	24.7	25.6	26.9	27.9	28.6	17.1	19.1	21.1	23.1	26.1	29.0	31.9	123.0
123.5	19.6	20.0	20.8	21.7	22.3	22.9	23.4	24.1	24.9	25.9	27.2	28.3	29.0	17.3	19.3	21.3	23.4	26.4	29.3	32.3	123.5
124.0	19.7	20.2	21.0	21.9	22.5	23.1	23.6	24.4	25.2	26.2	27.5	28.6	29.3	17.4	19.5	21.6	23.6	26.7	29.7	32.8	124.0
124.5	19.9	20.4	21.2	22.1	22.8	23.3	23.9	24.6	25.5	26.5	27.8	29.0	29.7	17.6	19.7	21.8	23.9	27.0	30.1	33.2	124.5
125.0	20.1	20.6	21.4	22.3	23.0	23.6	24.1	24.9	25.8	26.8	28.2	29.3	30.1	17.8	19.9	22.0	24.1	27.3	30.5	33.7	125.0
125.5	20.3	20.8	21.6	22.5	23.2	23.8	24.3	25.2	26.1	27.1	28.5	29.7	30.5	17.9	20.1	22.2	24.3	27.6	30.9	34.2	125.5
126.0	20.5	21.0	21.8	22.8	23.5	24.0	24.6	25.4	26.4	27.4	28.9	30.1	30.9	18.1	20.2	22.4	24.6	28.0	31.3	34.7	126.0
126.5	20.7	21.2	22.0	23.0	23.7	24.3	24.9	25.7	26.7	27.8	29.3	30.5	31.3	18.2	20.4	22.7	24.9	28.3	31.7	35.2	126.5

TABLE 12—*Continued*

Stature cm	Centiles													Standard deviations							Stature cm
	3rd	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th	97th	−3S.D.	−2S.D.	−1S.D.	MEDIAN	+1S.D.	+2S.D.	+3S.D.	
127.0	20.9	21.4	22.2	23.2	23.9	24.6	25.1	26.0	27.0	28.1	29.6	30.9	31.8	18.4	20.6	22.9	25.1	28.6	32.2	35.7	127.0
127.5	21.1	21.6	22.5	23.5	24.2	24.8	25.4	26.3	27.3	28.4	30.0	31.3	32.2	18.6	20.8	23.1	25.4	29.0	32.6	36.2	127.5
128.0	21.3	21.9	22.7	23.7	24.5	25.1	25.7	26.6	27.6	28.8	30.4	31.8	32.6	18.7	21.0	23.3	25.7	29.4	33.1	36.8	128.0
128.5	21.5	22.1	22.9	24.0	24.7	25.3	25.9	26.9	27.9	29.1	30.8	32.2	33.1	18.9	21.2	23.6	25.9	29.7	33.6	37.4	128.5
129.0	21.7	22.3	23.2	24.2	25.0	25.6	26.2	27.2	28.3	29.5	31.2	32.7	33.6	19.0	21.4	23.8	26.2	30.1	34.0	37.9	129.0
129.5	21.9	22.5	23.4	24.5	25.2	25.9	26.5	27.5	28.6	29.9	31.7	33.1	34.1	19.2	21.6	24.1	26.5	30.5	34.5	38.6	129.5
130.0	22.1	22.7	23.6	24.7	25.5	26.2	26.8	27.9	29.0	30.3	32.1	33.6	34.6	19.4	21.8	24.3	26.8	30.9	35.1	39.2	130.0
130.5	22.4	23.0	23.9	25.0	25.8	26.5	27.1	28.2	29.3	30.7	32.5	34.1	35.1	19.5	22.1	24.6	27.1	31.3	35.6	39.8	130.5
131.0	22.6	23.2	24.1	25.2	26.1	26.8	27.4	28.5	29.7	31.1	33.0	34.6	35.6	19.7	22.3	24.8	27.4	31.8	36.1	40.5	131.0
131.5	22.8	23.4	24.4	25.5	26.3	27.1	27.7	28.9	30.1	31.5	33.5	35.1	36.1	19.9	22.5	25.1	27.7	32.2	36.7	41.1	131.5
132.0	23.0	23.6	24.6	25.8	26.6	27.4	28.0	29.2	30.5	31.9	33.9	35.6	36.7	20.0	22.7	25.4	28.0	32.6	37.2	41.8	132.0
132.5	23.2	23.9	24.9	26.1	26.9	27.7	28.4	29.6	30.8	32.3	34.4	36.1	37.3	20.2	22.9	25.6	28.4	33.1	37.8	42.6	132.5
133.0	23.5	24.1	25.1	26.3	27.2	28.0	28.7	29.9	31.2	32.8	34.9	36.7	37.8	20.4	23.1	25.9	28.7	33.6	38.4	43.3	133.0
133.5	23.7	24.4	25.4	26.6	27.5	28.3	29.0	30.3	31.6	33.2	35.4	37.3	38.4	20.5	23.4	26.2	29.0	34.0	39.0	44.0	133.5
134.0	23.9	24.6	25.7	26.9	27.8	28.6	29.4	30.7	32.1	33.7	36.0	37.8	39.0	20.7	23.6	26.5	29.4	34.5	39.7	44.8	134.0
134.5	24.1	24.8	25.9	27.2	28.2	29.0	29.7	31.0	32.5	34.2	36.5	38.4	39.7	20.8	23.8	26.8	29.7	35.0	40.3	45.6	134.5
135.0	24.4	25.1	26.2	27.5	28.5	29.3	30.1	31.4	32.9	34.6	37.0	39.0	40.3	21.0	24.0	27.0	30.1	35.5	41.0	46.4	135.0
135.5	24.6	25.3	26.5	27.8	28.8	29.6	30.4	31.8	33.4	35.1	37.6	39.6	41.0	21.2	24.3	27.3	30.4	36.0	41.6	47.2	135.5
136.0	24.9	25.6	26.7	28.1	29.1	30.0	30.8	32.2	33.8	35.6	38.2	40.3	41.6	21.3	24.5	27.6	30.8	36.5	42.3	48.1	136.0
136.5	25.1	25.9	27.0	28.4	29.5	30.3	31.1	32.6	34.3	36.1	38.8	40.9	42.3	21.5	24.7	27.9	31.1	37.1	43.0	49.0	136.5
137.0	25.3	26.1	27.3	28.8	29,8	30.7	31.5	33.1	34.7	36.7	39.4	41.6	43.0	21.7	25.0	28.2	31.5	37.6	43.7	49.9	137.0

TABLE 2

Standards for Male Arm Muscle Circumference

Age Group	*Arm Muscle Circumference (mm)*						
	5	*10*	*25*	*50*	*75*	*90*	*95*
1– 1.9	110	113	119	127	135	144	147
2– 2.9	111	114	122	130	140	146	150
3– 3.9	117	123	131	137	143	148	153
4– 4.9	123	126	133	141	148	156	159
5– 5.9	128	133	140	147	154	162	169
6– 6.9	131	135	142	151	161	170	177
7– 7.9	137	139	151	160	168	177	190
8– 8.9	140	145	154	162	170	182	187
9– 9.9	151	154	161	170	183	196	202
10–10.9	156	160	166	180	191	209	221
11–11.9	159	165	173	183	195	205	230
12–12.9	167	171	182	195	210	223	241
13–13.9	172	179	196	211	226	238	245
14–14.9	189	199	212	223	240	260	264
15–15.9	199	204	218	237	254	266	272
16–16.9	213	225	234	249	269	287	296
17–17.9	224	231	245	258	273	294	312
18–18.9	226	237	252	264	283	298	324
19–24.9	238	245	257	273	289	309	321
25–34.9	243	250	264	279	298	314	326
35–44.9	247	255	269	286	302	318	327
45–54.9	239	249	265	281	300	315	326
55–64.9	236	245	260	278	295	310	320
65–74.9	223	235	251	268	284	298	306

Standards for Female Arm Muscle Circumference

Age Group	*Arm Muscle Circumference (mm)*						
	5	*10*	*25*	*50*	*75*	*90*	*95*
1– 1.9	105	111	117	124	132	139	143
2– 2.9	111	114	119	126	133	142	147
3– 3.9	113	119	124	132	140	146	152
4– 4.9	115	121	128	136	144	152	157
5– 5.9	125	128	134	142	151	159	165
6– 6.9	130	133	138	145	154	166	171
7– 7.9	129	135	142	151	160	171	176
8– 8.9	138	140	151	160	171	183	194
9– 9.9	147	150	158	167	180	194	198
10–10.9	148	150	159	170	180	190	197
11–11.9	150	158	171	181	196	217	223
12–12.9	162	166	180	191	201	214	220
13–13.9	169	175	183	198	211	226	240
14–14.9	174	179	190	201	216	232	247
15–15.9	175	178	189	202	215	228	244
16–16.9	170	180	190	202	216	234	249
17–17.9	175	183	194	205	221	239	257
18–18.9	174	179	191	202	215	237	245
19–24.9	179	185	195	207	221	236	249
25–34.9	183	188	199	212	228	246	264
35–44.9	186	192	205	218	236	257	272
45–54.9	187	193	206	220	238	260	274
55–64.9	187	196	209	225	244	266	280
65–74.9	185	195	208	225	244	264	279

TABLE 3

Standards for Male Upper Arm Muscle Area

Age Group	*Arm Muscle Area Percentiles (mm^2)*						
	5	*10*	*25*	*50*	*75*	*90*	*95*
1– 1.9	956	1014	1133	1278	1447	1644	1720
2– 2.9	973	1040	1190	1345	1557	1690	1787
3– 3.9	1095	1201	1357	1484	1618	1750	1853
4– 4.9	1207	1264	1408	1579	1747	1926	2008
5– 5.9	1298	1411	1550	1720	1884	2089	2285
6– 6.9	1360	1447	1605	1815	2056	2297	2493
7– 7.9	1497	1548	1808	2027	2246	2494	2886
8– 8.9	1550	1664	1895	2089	2296	2628	2788
9– 9.9	1811	1884	2067	2288	2657	3053	3257
10–10.9	1930	2027	2182	2575	2903	3486	3882
11–11.9	2016	2156	2382	2670	3022	3359	4226
12–12.9	2216	2339	2649	3022	3496	3968	4640
13–13.9	2363	2546	3044	3553	4081	4502	4794
14–14.9	2830	3147	3586	3963	4575	5368	5530
15–15.9	3138	3317	3788	4481	5134	5631	5900
16–16.9	3625	4044	4352	4951	5753	6576	6980
17–17.9	3998	4252	4777	5286	5950	6886	7726
18–18.9	4070	4481	5066	5552	6374	7067	8355
19–24.9	4508	4777	5274	5913	6660	7606	8200
25–34.9	4694	4963	5541	6214	7067	7847	8436
35–44.9	4844	5181	5740	6490	7265	8034	8488
45–54.9	4546	4946	5589	6297	7142	7918	8458
55–64.9	4422	4783	5381	6144	6919	7670	8149
65–74.9	3973	4411	5031	5716	6432	7074	7453

Standards for Female Upper Arm Muscle Area

Age Group	*Arm Muscle Area Percentiles (mm^2)*						
	5	*10*	*25*	*50*	*75*	*90*	*95*
1– 1.9	885	973	1084	1221	1378	1535	1621
2– 2.9	973	1029	1119	1269	1405	1595	1727
3– 3.9	1014	1133	1227	1396	1563	1690	1846
4– 4.9	1058	1171	1313	1475	1644	1832	1958
5– 5.9	1238	1301	1423	1598	1825	2012	2159
6– 6.9	1354	1414	1513	1683	1877	2182	2323
7– 7.9	1330	1441	1602	1815	2045	2332	2469
8– 8.9	1513	1566	1808	2034	2327	2657	2996
9– 9.9	1723	1788	1976	2227	2571	2987	3112
10–10.9	1740	1784	2019	2296	2583	2873	3093
11–11.9	1784	1987	2316	2612	3071	3739	3953
12–12.9	2092	2182	2579	2904	3225	3655	3847
13–13.9	2269	2426	2657	3130	3529	4081	4568
14–14.9	2418	2562	2874	3220	3704	4294	4850
15–15.9	2426	2518	2847	3248	3689	4123	4756
16–16.9	2308	2567	2865	3248	3718	4353	4946
17–17.9	2442	2674	2996	3336	3883	4552	5251
18–18.9	2398	2538	2917	3243	3694	4461	4767
19–24.9	2538	2728	3026	3406	3877	4439	4940
25–34.9	2661	2826	3148	3573	4138	4806	5541
35–44.9	2750	2948	3359	3783	4428	5240	5877
45–54.9	2784	2956	3378	3858	4520	5375	5964
55–64.9	2784	3063	3477	4045	4750	5632	6247
65–74.9	2737	3018	3444	4019	4739	5566	6214

TABLE 4

Standards for Male Upper Arm Fat Area

Age Group	*Arm Fat Area Percentiles (mm^2)*						
	5	*10*	*25*	*50*	*75*	*90*	*95*
1– 1.9	452	486	590	741	895	1036	1176
2– 2.9	434	504	578	737	871	1044	1148
3– 3.9	464	519	590	736	868	1071	1151
4– 4.9	428	494	598	722	859	989	1085
5– 5.9	446	488	582	713	914	1176	1299
6– 6.9	371	446	539	678	896	1115	1519
7– 7.9	423	473	574	758	1011	1393	1511
8– 8.9	410	460	588	725	1003	1248	1558
9– 9.9	485	527	635	859	1252	1864	2081
10–10.9	523	543	738	982	1376	1906	2609
11–11.9	536	595	754	1148	1710	2348	2574
12–12.9	554	650	874	1172	1558	2536	3580
13–13.9	475	570	812	1096	1702	2744	3322
14–14.9	453	563	786	1082	1608	2746	3508
15–15.9	521	595	690	931	1423	2434	3100
16–16.9	542	593	844	1078	1746	2280	3041
17–17.9	598	698	827	1096	1636	2407	2888
18–18.9	560	665	860	1264	1947	3302	3928
19–24.9	594	743	963	1406	2231	3098	3652
25–34.9	675	831	1174	1752	2459	3246	3786
35–44.9	703	851	1310	1792	2463	3098	3624
45–54.9	749	922	1254	1741	2359	3245	3928
55–64.9	658	839	1166	1645	2236	2976	3466
65–74.9	573	753	1122	1621	2199	2876	3327

Standards for Female Upper Arm Fat Area

Age Group	*Arm Fat Area Percentiles (mm^2)*						
	5	*10*	*25*	*50*	*75*	*90*	*95*
1– 1.9	401	466	578	706	847	1022	1140
2– 2.9	469	526	642	747	894	1061	1173
3– 3.9	473	529	656	822	967	1106	1158
4– 4.9	490	541	654	766	907	1109	1236
5– 5.9	470	529	647	812	991	1330	1536
6– 6.9	464	508	638	827	1009	1263	1436
7– 7.9	491	560	706	920	1135	1407	1644
8– 8.9	527	634	769	1042	1383	1872	2482
9– 9.9	642	690	933	1219	1584	2171	2524
10–10.9	616	702	842	1141	1608	2500	3005
11–11.9	707	802	1015	1301	1942	2730	3690
12–12.9	782	854	1090	1511	2056	2666	3369
13–13.9	726	838	1219	1625	2374	3272	4150
14–14.9	981	1043	1423	1818	2403	3250	3765
15–15.9	839	1126	1396	1886	2544	3093	4195
16–16.9	1126	1351	1663	2006	2598	3374	4236
17–17.9	1042	1267	1463	2104	2977	3864	5159
18–18.9	1003	1230	1616	2104	2617	3508	3733
19–24.9	1046	1198	1596	2166	2959	4050	4896
25–34.9	1173	1399	1841	2548	3512	4690	5560
35–44.9	1336	1619	2158	2898	3932	5093	5847
45–54.9	1459	1803	2447	3244	4229	5416	6140
55–64.9	1345	1879	2520	3369	4360	5276	6152
65–74.9	1363	1681	2266	3063	3943	4914	5530

TABLES 5

Standards for Triceps Skinfold*

	Triceps Skinfold Percentiles (mm^2)													
	Males							*Females*						
Age Group	5	10	25	50	75	90	95	5	10	25	50	75	90	95
1– 1.9	6	7	8	10	12	14	16	6	7	8	10	12	14	16
2– 2.9	6	7	8	10	12	14	15	6	8	9	10	12	15	16
3– 3.9	6	7	8	10	11	14	15	7	8	9	11	12	14	15
4– 4.9	6	6	8	9	11	12	14	7	8	8	10	12	14	16
5– 5.9	6	6	8	9	11	14	15	6	7	8	10	12	15	18
6– 6.9	5	6	7	8	10	13	16	6	6	8	10	12	14	16
7– 7.9	5	6	7	9	12	15	17	6	7	9	11	13	16	18
8– 8.9	5	6	7	8	10	13	16	6	8	9	12	15	18	24
9– 9.9	6	6	7	10	13	17	18	8	8	10	13	16	20	22
10–10.9	6	6	8	10	14	18	21	7	8	10	12	17	23	27
11–11.9	6	6	8	11	16	20	24	7	8	10	13	18	24	28
12–12.9	6	6	8	11	14	22	28	8	9	11	14	18	23	27
13–13.9	5	5	7	10	14	22	26	8	8	12	15	21	26	30
14–14.9	4	5	7	9	14	21	24	9	10	13	16	21	26	28
15–15.9	4	5	6	8	11	18	24	8	10	12	17	21	25	32
16–16.9	4	5	6	8	12	16	22	10	12	15	18	22	26	31
17–17.9	5	5	6	8	12	16	19	10	12	13	19	24	30	37
18–18.9	4	5	6	9	13	20	24	10	12	15	18	22	26	30
19–24.9	4	5	7	10	15	20	22	10	11	14	18	24	30	34
25–34.9	5	6	8	12	16	20	24	10	12	16	21	27	34	37
35–44.9	5	6	8	12	16	20	23	12	14	18	23	29	35	38
45–54.9	6	6	8	12	15	20	25	12	16	20	25	30	36	40
55–64.9	5	6	8	11	14	19	22	12	16	20	25	31	36	38
65–74.9	4	6	8	11	15	19	22	12	14	18	24	29	34	36

*These percentiles were derived from data obtained on all white subjects in the United Health and Nutrition Examination Survey 1971–1974. (From Frisancho, A.R.: New norms of upper limb fat and muscle areas for assessment of nutrition status . Am. J. Clin. Nutr. 34 2540, 1981.)

Appendix II(C)

ANTHROPOMETRIC MEASUREMENTS OF MALE AND FEMALE INDIAN CHILDREN FROM HIGH SOCIO ECONOMIC GROUP (0–10 YEARS)*

*SOURCE: Ghosh, Shanti.: A longitudinal study of the outcome of a birth cohort. Project no. 01–658–2, 1986.

TABLE 1

Anthropometric Measurements (50th centiles) of Male Children (0–10 years)

Age in months	*Weight*+ *(kg)*	*Height (cm)*	*Head circumference (cm)*
Birth	2.97	49.3	33.9
6	7.44	66.9	42.4
12	9.45	74.5	45.2
18	10.49	80.0	46.6
24	11.56	84.9	47.3
30	12.38	88.6	48.1
36	13.52	93.4	48.5
42	15.07	97.0	49.1
48	15.23	100.1	49.5
54	16.31	103.2	49.9
60	17.02	106.9	50.4
66	18.24	110.3	50.7
72	19.33	113.6	50.9
78	20.24	106.4	51.2
84	21.06	119.1	51.5
90	22.37	121.7	51.6
96	23.45	124.8	51.7
102	24.62	127.2	51.9
108	25.55	129.0	52.1
114	27.61**	132.5	52.3
120	28.95	137.2	53.0

+ Means are provided as 50th centiles are not available.

** Sample size is only 4.

TABLE 2

Anthropometric Measurements (50th centiles) of Female Children (0–10 years)

Age in months	*Weight (kg)*	*Height (cm)*	*Head circumference (cm)*
Birth	2.96	48.8	33.4
6	6.86	65.2	41.1
12	8.76	72.5	43.8
18	9.84	78.3	45.3
24	10.92	82.8	46.1
30	11.79	86.9	46.6
36	12.96	92.2	47.4
42	13.74	94.9	47.8
48	14.46	98.9	48.4
54	15.47	102.6	49.1
60	16.32	105.6	49.2
66	17.32	109.1	49.7
72	18.16	111.9	49.9
78	18.93	114.5	50.2
84	20.74	118.6	50.7
90	21.59	121.1	50.7
96	22.42	121.9	51.2
102	23.07	125.5	51.2
108	24.26**	127.2	51.4
114	27.87**	132.6	52.5
120	32.21**	135.6	52.6

** Sample sizes are below 8—the reason for value of females more than value of males for weight.

Appendix II(D)

ANTHROPOMETRIC STANDARDS OF WELL-NOURISHED INDIAN CHILDREN (HEIGHT, WEIGHT, MID-UPPER-ARM-CIRCUMFERENCE & FAT FOLD AT TRICEPS)*

*SOURCE: 1. Vijayaraghavan, K., Darshan Singh and Swaminathan, M. C.: Heights and Weights in Well-nourished Indian Schoolchildren. *I.J.M.R.*, **59**, 648–54, 1971.

2. Vijayaraghavan, K., Darshan Singh and Swaminathan, M. C.: Arm Circumference and Fat Fold at Triceps in Well-nourished Indian Schoolchildren. *I.J.M.R.*, **62**, 994–1001, 1974.

TABLE 1

Mean ± SD, and Median for Heights and Weights of Well-to-do Indian Children*

Boys				*Age in*	*Girls*			
Ht (cm)		*Wt (kg)*			*Ht (cm)*		*Wt (kg)*	
Mean ± SD	Median	Mean ± SD	Median	yrs	Mean ± SD	Median	Mean ± SD	Median
113.50±5.54	112.00	19.33±5.70	19.17	5	112.24±3.91	112.50	18.67±1.89	18.60
118.90±5.19	118.88	22.14±3.30	21.88	6	117.73±5.08	117.78	21.56±3.44	20.52
123.32±5.71	123.20	24.46±4.15	24.25	7	122.65±5.79	123.20	24.45±4.41	23.75
127.86±5.66	127.85	26.42±4.43	26.06	8	127.22±6.58	127.20	25.97±4.87	25.96
133.63±7.08	133.30	30.00±5.61	29.18	9	133.08±6.55	132.54	29.82±6.12	28.96
138.45±6.82	138.04	32.39±5.94	31.0	10	138.9 ±6.35	138.19	33.58±4.79	32.55
143.35±7.22	142.73	35.26±6.68	33.96	11	145.0 ±7.44	145.11	37.17±6.87	36.26
148.91±8.45	148.40	38.78±7.67	37.75	12	150.98±6.28	151.47	42.97±7.35	42.51
154.94±8.67	155.00	42.88±8.13	42.38	13	153.44±6.17	153.75	44.54±7.11	43.85
161.70±8.43	162.58	48.26±8.66	47.29	14	155.04±5.44	154.54	46.70±6.78	45.00
165.33±6.92	165.45	52.15±8.13	51.14	15	155.98±7.73	155.73	48.75±6.70	47.27
168.40±6.36	168.39	55.54±8.17	54.75	16	156.00±5.97	155.70	49.75±5.80	49.00

* A cross-sectional study was undertaken to obtain data on growth and development of normal, healthy children subsisting on adequate diets from 14 public schools in different parts of India. These schools were residential schools of the type of English Public Schools and catered to the educational needs of the elite of the society. All the public schools were selected from a list of public schools in India (Sainik schools were excluded).

TABLE 2

Arm Circumference (cm) for Age of Well-to-do Indian Children*

Boys							Age	Girls						
		Percentiles								Percentiles				
No.	Mean±SD	5	25	50	75	95	(yrs)	No.	Mean±SD	5	25	50	75	95
18	16.42±1.7038	14.36	15.25	16.00	17.10	20.40	5–6	16	16.30±1.3103	14.36	15.40	16.10	16.60	18.68
118	16.68±1.5471	14.23	15.56	16.50	17.53	19.24	6–7	65	16.96±1.6041	15.18	15.85	16.53	17.55	20.35
194	17.36±1.8539	15.17	16.14	17.15	18.18	20.67	7–8	98	17.70±2.1415	14.63	16.32	17.33	18.46	21.48
243	17.72±2.0319	15.23	16.32	17.43	18.46	21.58	8–9	102	18.00±2.1596	15.12	16.17	17.45	19.45	21.98
323	18.55±2.2931	15.88	17.06	18.12	19.50	22.39	9–10	128	18.75±2.4444	15.43	17.05	18.32	20.10	23.36
466	18.98±2.4133	16.05	17.37	18.49	20.11	23.58	10–11	121	19.28±2.2616	16.32	17.91	19.14	20.46	23.59
666	19.58±1.2879	16.50	17.92	19.16	20.59	24.09	11–12	143	19.78±2.3132	16.45	18.34	19.51	21.15	23.79
748	20.29±2.4506	16.89	18.60	20.11	21.59	24.64	12–13	158	21.04±2.5669	17.19	19.26	20.82	22.65	26.20
764	21.09±2.4817	17.53	19.29	20.78	22.55	25.82	13–14	164	21.43±2.7628	17.82	19.47	21.06	23.25	26.52
703	22.22±2.5659	18.45	20.43	21.95	23.72	26.94	14–15	169	22.06±2.6008	18.22	20.24	21.78	23.63	26.82
589	23.22±2.5040	19.59	21.40	22.98	24.74	27.72	15–16	134	22.62±2.5424	19.10	21.05	22.57	24.10	27.12
279	24.06±2.5816	20.18	22.41	23.94	25.45	28.69	16–17	71	23.24±2.7839	19.07	21.38	22.96	24.54	28.79
61	24.82±3.0348	21.01	22.65	24.11	26.15	31.79	17–18	25	22.35±2.5068	18.30	20.70	22.10	23.70	27.95

* A cross-sectional study was undertaken to obtain data on growth and development of normal, healthy children subsisting on adequate diets from 14 public schools in different parts of India. These schools were residential schools of the type of English Public Schools and catered to the educational needs of the elite of the society. All the public schools were selected from a list of public schools in India (Sainik schools were excluded).

TABLE 3

Fat Fold at Triceps (mm) for Age of Well-to-do Indian Children*

Boys							Age	Girls						
		Percentiles								Percentiles				
No.	Mean ± SD	5	25	50	75	95	(yrs)	No.	Mean ± SD	5	25	50	75	95
18	7.56±2.9401	3.90	6.10	6.50	7.90	14.50	5–6	16	9.56±1.8786	6.80	8.20	9.00	11.33	12.60
118	8.14±2.2891	5.38	6.60	7.68	9.04	13.37	6–7	65	10.1 ±2.4162	7.10	8.17	9.69	11.44	14.75
194	8.74±3.0412	5.48	6.77	8.11	9.64	14.45	7–8	98	10.67±3.6469	6.56	8.12	9.87	11.94	17.55
243	8.66±3.0587	5.21	6.76	7.97	9.63	14.57	8–9	102	10.66±3.5028	6.31	7.96	10.07	12.64	17.30
323	9.22±3.5121	5.46	7.01	8.33	10.15	16.57	9–10	128	11.05±3.7457	6.06	8.37	10.30	13.25	18.80
466	9.50±3.6995	5.45	6.93	8.54	10.90	17.60	10–11	121	11.15±3.5833	6.26	8.77	10.59	12.78	18.47
666	9.58±3.4875	5.33	7.14	8.80	11.15	16.58	11–12	143	11.19±3.8789	7.05	8.44	10.19	12.91	19.48
749	9.84±3.9091	5.37	7.26	8.93	11.46	16.79	12–13	158	12.75±4.2591	7.25	9.65	12.12	14.97	20.02
764	9.49±3.8404	5.38	7.03	8.49	10.95	17.18	13–14	184	13.20±4.9295	6.75	9.71	12.72	15.63	21.90
703	9.08±3.5250	5.11	6.77	8.32	10.48	15.15	14–15	169	13.72±4.2059	7.36	10.94	12.82	16.72	21.26
589	9.03±3.0795	5.20	6.64	8.14	10.39	15.82	15–16	134	14.08±4.4794	8.34	11.05	13.17	16.25	22.32
279	9.21 ±3.9912	5.08	6.40	8.02	10.90	18.02	16–17	71	14.46±4.6119	8.18	10.97	14.08	16.56	23.82
61	9.32 ±4.7592	5.01	6.48	7.68	10.25	18.98	17–18	25	13.46±4.3635	7.42	11.08	12.88	15.25	20.88

* A cross-sectional study was undertaken to obtain data on growth and development of normal, healthy children subsisting on adequate diets from 14 public schools in different parts of India. These schools were residential schools of the type of English Public Schools and catered to the educational needs of the elite of the society. All the public schools were selected from a list of public schools in India (Sainik schools were excluded).

Appendix III

INTERPRETATION OF ANTHROPOMETRIC STANDARDS & CLASSIFICATIONS IN USE

The objective of this appendix is to present a compilation of different classifications of malnutrition currently in use. These classifications will help in interpretation of the anthropometric data.

WEIGHT-FOR-AGE

(1) *Gomez Classification*:*

≤60%	weight-for-age	:	Grade III malnutrition
61–75%	weight-for-age	:	Grade II malnutrition
76–90%	weight-for-age	:	Grade I malnutrtion
>90%	weight-for-age	:	Normal

(2) *Indian Academy of Paediatrics Classification:*

≤50%	weight-for-age	:	Grade IV
51–60%	weight-for-age	:	Grade III malnutrition
61–70%	weight-for-age	:	Grade II malnutrition
71–80%	weight-for-age	:	Grade I malnutrition
>80%	weight-for-age	:	Normal

HEIGHT-FOR-AGE

(1) *Mclaren's Classification:*

<80%	:	Dwarf
80–93%	:	Short
93–105%	:	Normal

(2) *Vishveshwara Rao's Classification:*

<80%	of the standard	:	Poor
80–90%	of the standard	:	Mild retardation
91–100%	of the standard	:	Normal

* ≤ means 'less than or equal to'.

(3) *Waterlow's Classification:*

<85%	expected height-for-age	: Severe malnutrition
85–90%	expected height-for-age	: Moderate malnutritio
90–95%	expected height-for-age	: Marginal malnutritio
>95%	expected height-for-age	: Normal

WEIGHT-FOR-HEIGHT

(1)

<75%	weight-for-height	: Severe malnutrition
75–84%	weight-for-height	: Moderate malnutrition
85–90%	weight-for-height	: Marginal malnutrition
>90%	weight-for-height	: Normal

WATERLOW'S QUALITATIVE CLASSIFICATION BASED ON HEIGHT-FOR-AGE AND WEIGHT-FOR-HEIGHT

Normal	:	weight-for-height	≥80% standard
		height-for-age	≥90% standard
Stunted	:	weight-for-height	≥80% standard
		height-for-age	<90% standard
Wasted	:	weight-for-height	<80% standard
		height-for-age	≥90% standard
Wasted and Stunted	:	weight-for-height	<80% standard
		height-for-age	<90% standard

MID-UPPER-ARM-CIRCUMFERENCE (MUAC)

<12.5 cm	:	Severe malnutrition
12.5–13.5 cm	:	Moderate malnutrition
>13.5 cm	:	Normal

SKINFOLD OVER TRICEPS (SFT)

<60%	:	Severe malnutrition
60–80%	:	Moderate malnutrition
80–90%	:	Mild malnutrition
90–110%	:	Normal

The height, weight and MUAC standards given in Appendix II may be used as the reference standards for classifying children into different grades of malnutrition.

HEAD CIRCUMFERENCE

At birth, the head circumference is about 2 cm more than the chest circumference. By about 6 to 9 months the two measurements become equal, after which the chest circumference becomes more than the head circumference. In severely undernourished children, this may be delayed by 3 to 4 years.

RATIOS OF ANTHROPOMETRIC MEASUREMENTS

(1) *Head/chest circumference ratio* (for children above 6 months of age)

<1	:	normal
$\geqslant 1$	:	malnourished

(2) *Mid-arm circumference/head circumference ratio* (Kanawati and Mclaren)

$\geqslant 0.35$	:	Obese
0.31–0.34	:	Normal
0.28–0.30	:	Mild malnutrition
0.25–0.28	:	Moderate malnutrition
$\leqslant 0.25$	:	Severe malnutrition

(3) *Weight/height*^{2} (Rao & Singh)

>0.0015	:	Normal
0.0013–0.0015	:	Moderate malnutrition
<0.0013	:	Undernourished

Appendix IV

A GUIDE TO THE CLINICAL SIGNS OF MALNUTRITION*

*SOURCE: Jelliffe, D. B. *The Assessment of the Nutritional Status of the Community.* World Health Organization. Geneva, 1966.

CLINICAL EXAMINATION

Clinical examination is an important practical method for assessing the nutritional status of a community.

The method for clinical examination is usually based on examination for changes, believed to be related to inadequate nutrition, that can be seen or felt in superficial epithelial tissues, especially the skin, eyes, hair and buccal mucosa, or in organs near the surface of the body, such as the parotid and thyroid glands.

Clinical assessment of a community can give valuable information to the public health worker, especially in regions of the world where malnutrition is widespread.

CLASSIFIED LIST OF SIGNS USED IN NUTRITION SURVEYS

According to the report of the WHO Expert Committee on Medical Assessment of Nutritional Status, the signs and symptoms that are considered to be of value in nutritional assessment are recorded as follows:

	Signs known to be of value in nutrition surveys
(1) Hair	—Lack of lustre —Thinness and sparseness —Straightness —Dyspigmentation —Flag Sign —Easy pluckability
(2) Face	—Diffuse depigmentation —Naso-labial dyssebacea —Moon face

	Signs known to be of value in nutrition surveys
(3) Eyes	—Pale conjunctiva —Bitot's spots —Conjunctival xerosis —Corneal xerosis —Keratomalacia —Angular palpebritis
(4) Lips	—Angular stomatitis —Angular scars —Cheilosis
(5) Tongue	—Oedema —Scarlet and raw tongue —Magenta tongue —Atrophic papillae
(6) Teeth	—Mottled enamel
(7) Gums	—Spongy, bleeding gums
(8) Glands	—Thyroid enlargement —Parotid enlargement
(9) Skin	—Xerosis —Follicular hyperkeratosis—types 1 and 2 —Petechiae —Pellagrous dermatosis —Flaky-paint dermatosis —Scrotal and vulval dermatosis
(10) Nails	—Koilonychia
(11) Subcutaneous tissue	—Oedema —Amount of subcutaneous fat
(12) Muscular and Skeletal systems	—Muscle wasting —Craniotabes —Frontal and parietal bossing —Epiphyseal enlargement (tender or painless) —Beading of ribs —Persistently open anterior fontanelle —Knock-knees or bow-legs —Diffuse or local skeletal deformities —Deformities of thorax (selected) —Musculo-skeletal haemorrhages

	Signs known to be of value in nutrition surveys
(13) Internal Systems:	
(a) Gastro-intestinal	—Hepatomegaly
(b) Nervous*	—Psychomotor change —Mental confusion —Sensory loss —Motor weakness —Loss of position sense —Loss of vibratory sense —Loss of ankle and knee jerks —Calf tenderness
(c) Cardiovascular	—Cardiac enlargement —Tachycardia

*The symptoms described under this section may be seen in lathyrism and 'tropical neuropathies'. Further confirmatory tests for these will be required in community surveys.

INTERPRETATION

The relatively easy organization and inexpensive nature of nutritional assessment by means of clinical examination may make it appear that the method is simple, quickly mastered by the beginner and yields results that are easy to interpret. This is not the case. Various non-nutritional environmental influences may be responsible for identical appearances. Further, most signs of malnutrition are not specific to lack of one nutrient and can often be produced by various non-nutritional factors.

However, the fact that most clinical signs are non-specific does not preclude their use as indices of malnutrition. The interpretation of clinical signs can be best made by using a 'grouping of signs' which have been commonly found to form a pattern as associated with the deficiency of a particular nutrient.

The following section discusses the groupings of clinical signs and their interpretation with respect to certain nutritional deficiency diseases.

GUIDE TO THE INTERPRETATION OF GROUPINGS OF CLINICAL SIGNS

(1) *Protein-Calorie malnutrition (PCM)*

(a) *PCM in adults and schoolchildren*:

The usual signs are:

diminished subcutaneous fat, and
muscle wasting.

Other associated signs may include:

parotid enlargement (especially in schoolchildren),
oedema of the ankles, and
gynaecomastia in males.

(b) *PCM in young children*:

The signs suggestive of PCM in young children are:

oedema,
dyspigmentation of the hair,
thin sparse hair,
straight hair,
muscle wasting,
diffuse depigmentation of the skin,
psychomotor change,
moon face,
hepatomegaly (enlargement of liver), and
flaky-paint dermatosis.

(c) *Calorie overnutrition in children and adults (obesity)*:

The signs of calorie overnutrition are:

increased subcutaneous fat, and
increased abdominal girth.

(2) *Vitamin A deficiency*

The signs suggestive of Vitamin A deficiency are:

Bitot's spots,
conjunctival xerosis,
corneal xerosis,
keratomalacia,
xerosis of skin, and
follicular hyperkeratosis (type 1).

The clinical signs of avitaminosis A vary with age. In particular, keratomalacia is principally seen in infancy and the pre-school age group, often associated with PCM; while Bitot's spots and conjunctival

xerosis are more common in schoolchildren.

Recent studies have suggested that both xerosis of the skin and follicular hyperkeratosis (type 1) are more usually due not to lack of Vitamin A but to deficiency of unsaturated fatty acids such as linoleic acid.

(3) *Riboflavin deficiency*

The signs suggestive of riboflavin deficiency are:

angular stomatitis (or angular scars),
cheilosis,
magenta tongue,
atrophic lingual papillae (smooth, glazed tongue),
dyssebacea,
angular palpebritis (angular blepharitis),
scrotal (or vulval) dermatosis, and
corneal vascularization.

Recent work has indicated the non-specificity of corneal vascularization and has also suggested that it is more commonly due to causes other than ariboflavinosis.

(4) *Thiamine deficiency*

The common suggestive signs are:

oedema,
loss of ankle and knee jerks,
motor weakness (Squatting test),
calf muscle tenderness,
sensory loss,
cardiac enlargement, and
tachycardia (increased palpitations).

Thiamine deficiency in babies (infantile beri beri) has a completely different picture. Usually it is one of convulsions and acute cardiac failure in the early months of life. Assessment of the incidence of this condition is difficult owing to the acuteness of the illness and because of the other diseases that produce a similar clinical picture at this age. The age-specific mortality rate between two and five months is a useful guide, while indirect evidence may be gained by estimating the thiamine content of breast milk.

(5) *Niacin deficiency*

The suggestive signs are:

pellagrous dermatosis,
scarlet and raw tongue,
atrophic lingual papillae (smooth glazed tongue),
tongue fissuring, and

molar and supraorbital pigmentation.

(6) *Vitamin C deficiency*

The signs suggestive of Vitamin C deficiency are:

spongy and bleeding gums,
petechiae (haemorrhages under the skin),
ecchymoses (blue stains on the skin due to petechiae),
follicular hyperkeratosis (type 2),
intramuscular or subperiosteal haematoma, and
epiphyseal enlargement (painful).

The clinical picture varies greatly with age. Infantile scurvy is characterized more by lassitude, anaemia, haematoma formation, especially subperiosteally, and painful epiphyseal enlargement, particularly at the costochondral junction. Spongy, bleeding gums do not occur in the absence of teeth.

When teeth are present, the commonest cause of bleeding gums in the absence of hypertrophy, is a varying degree of marginal gingivitis or pyorrhoea.

(7) *Vitamin D deficiency*

Active rickets (in young children) is typically suggested by:

epiphyseal enlargement (painless)—(over 6 months of age),
beading of ribs,
persistently open anterior fontanelle—(after 18 months of age),
craniotabes—(under 1 year of age), and
muscular hypotonia.

Healed rickets (in older children or adults) is suggested by:

frontal or parietal bossing,
knock-knees or bow-legs, and
deformities of the thorax (Harrison's sulcus and pigeon chest)

Osteomalacia (in adults) may give rise to:

local or generalized skeletal deformities, especially of the pelvis, with tender bones.

The lack of specificity of these signs has suggested that a minimum of three signs are needed for diagnosis, preferably backed by biochemical and radiographic evidence.

(8) *Iron deficiency*

Iron deficiency is suggested by:

pale conjunctiva,
koilonychia (in older children and adults), and
atrophic lingual papillae.

(9) *Folic acid or Vitamin B_{12} deficiency*

This condition is usually accompanied by pale conjunctiva due to anaemia.

(10) *Iodine deficiency*

A deficiency of iodine produces enlargement of the thyroid.

(11) *Excess of fluorine (fluorosis)*

An excess of fluorine is suggested by mottled dental enamel. This sign, however, has to be distinguished in its early stages from enamel hypoplasia and from various congenital conditions. Mottling of the finger nails may also be found.

In chronic advanced cases, radiographic examination of the spine will show increased density of the bones, with calcification of ligaments.

Appendix V(A)

BIOCHEMICAL INDICATORS OF NUTRITIONAL STATUS*

*SOURCE: Sauberlich, H. E., Dowdy, R. P. and Skala, J. H.: *Laboratory Tests for the Assessment of Nutritional Status*. CRC Press Inc., Cleveland, Ohio, 1977.

Biochemical measurements represent the most objective assessment of the nutritional status of an individual, frequently providing pre- or sub-clinical information. There are several biochemical indicators of malnutrition, specific for different nutritional deficiencies. In most instances, nutrient intakes are reflected in their levels present in blood/serum or urine. These levels can, at least in part, be defined or related to inadequate, low, adequate or high dietary intakes of the nutrient. Further, the biochemical changes often precede the clinical symptoms so that they may be used as early indicators of malnutrition.

Discussed below are the biochemical indicators for certain nutritional diseases.

1 PROTEIN-CALORIE MALNUTRITION

This is considered to represent the most common nutritional problem of children in developing countries. Unfortunately, there is no single biochemical procedure that can satisfactorily evaluate protein-calorie malnutrition in early or sub-clinical states. Nevertheless, the use of several biochemical measurements such as *serum total protein and albumin, serum amino acid ratios, urinary creatinine height index, urinary hydroxyproline index* and *fasting urinary urea-creatinine ratios*, if interpreted carefully and when used in conjunction with clinical and anthropometric assessments, provide a reasonable evaluation of protein and calorie nutritional status.

In cases of advanced PCM in adults and schoolchildren hypo-albuminaemia may be present. In young children, in addition to hypo-albuminaemia, a low urinary creatinine excretion may also be found. Further, poor dietary protein intake is reflected in a low excretion of urea per gram of creatinine. The serum amino acid imbalance test and the hydroxyproline excretion test may show abnormality too.

Tentative suggested guidelines for the interpretation of some of these biochemical indices used in evaluating PCM are given in Table 1.

TABLE 1

Biochemical Indices used in Evaluating PCM

Measurement Index	*Less than acceptable (at risk)*		*Acceptable (low risk)*
	Deficient (high risk)	*Low (medium risk)*	
(1) *Serum protein* (g/100 ml)			
0–11 months	—	<5.0	≥ 5.0
1–5 years	—	<5.5	≥ 5.5
6–17 years	—	<6.0	≥ 6.0
Adults	<6.0	6.0 to 6.4	≥ 6.5
Pregnant (2nd & 3rd trimester)	<5.5	5.5 to 5.9	≥ 6.0
(2) *Serum albumin* (g/100 ml)			
0–11 months	–	<2.5	≥ 2.5
1–5 years	<2.8	<3.0	≥ 3.0
6–17 years	<2.8	<3.5	≥ 3.5
Adults	<2.8	2.8 to 3.4	≥ 3.5
Pregnant (1st trimester)	<3.0	3.0 to 3.9	≥ 4.0
Pregnant (2nd & 3rd trimester)	<3.0	3.0 to 3.4	≥ 3.5
(3) *Non-essential/essential amino acid ratio* (NE/E)* (All ages)	>3.0	2.0 to 3.0	<2.0
(4) *Hydroxyproline index* (3 months to 10 years)	<1.0	1.0 to 2.0	> 2.0
(5) *Creatinine height index* (3 months to 17 years)	<0.5	0.5 to 0.9	> 0.9
(6) *Urea/Creatinine ratio*†	<6.0	6.0 to 12.0	>12.0

*The value depends upon the analytical method employed and the procedure used to calculate the ratio.

†These values are considered exceedingly tentative in view of the effect of age and the wide range of values reported in the literature.

2. VITAMIN A DEFICIENCY

Hypovitaminosis A is a major nutritional problem throughout the world, particularly in the developing countries.

The only practical biochemical test currently available to evaluate the Vitamin A status in population groups is the serum retinal determination, which provides a reflection of the Vitamin A intake. Further, since the vitamin is stored primarily in the liver, low serum levels of Vitamin A also reflect depleted liver stores.

Serum Vitamin A levels of 10 μg or less per 100 ml serum are indicative of depleted, or virtually no, liver reserves of the vitamin with clinical signs or symptoms of a deficiency generally evident.

However, it should be noted that depressed serum Vitamin A levels may also be encountered in conditions unrelated to nutrition, such as chronic infection, febrile conditions, liver diseases or sprue.

The guidelines that may be used to evaluate serum Vitamin A levels are indicated in Table 2.

TABLE 2

Evaluation of serum Vitamin A Levels

Measurement Index	*Less than acceptable (at risk)*		*Acceptable (low risk)*
	Deficient (high risk)	*Low (medium risk)*	
(1) *Plasma retinol* (mcg/dl) (All ages)	<10	10 to 19	≥20
(2) *Plasma carotene* (mcg/dl) (All ages)	—	20 to 39	≥40
Pregnant women:			
2nd trimester	—	30 to 79	≥80
3rd trimester	—	40 to 79	≥80

3. RIBOFLAVIN DEFICIENCY

Clinical cases of suspected riboflavin deficiency can be evaluated biochemically by measuring the riboflavin content of 24-hour urine collections and expressing the results in terms of μg per 24 hours and per gram of creatinine. The measurement of blood riboflavin levels has also been proposed to evaluate riboflavin nutritional status. When feasible, erythrocyte glutathione reductase activity coefficient values should also be determined.

Guidelines for the interpretation of the above biochemical indices with respect to the riboflavin status of individuals are listed in Table 3.

4. THIAMINE DEFICIENCY

The most commonly used procedure for the biochemical indication of thiamine deficiency is the measurement of urinary levels of thiamine. Analyses of 24-hour urine collections provide more reliable informa-

TABLE 3

Evaluation of Riboflavin Status

Index	*Less than acceptable (at risk)*		*Acceptable (low risk)*
	Deficient (high risk)	*Low (medium risk)*	
(1) *Urinary excretion of riboflavin* (μg/g creatinine)			
1–3 years	< 150	150 to 499	≥ 500
4–6 years	< 100	100 to 299	≥ 300
7–9 years	< 85	85 to 269	≥ 270
10–15 years	< 70	70 to 199	≥ 200
Adults	< 27	27 to 79	≥ 80
Pregnant (2nd trimester)	< 39	39 to 119	≥ 120
Pregnant (3rd trimester)	< 30	30 to 89	≥ 90
Adults: μg/24 hours	< 40	40 to 119	≥ 120
μg/6 hours	< 10	10 to 29	≥ 30
Load test (return in adults of 5 mg riboflavin dose)			
μg/4 hours	<1000	1000 to 1399	≥1400
(2) *Erythrocyte riboflavin* (μg/100 ml cells)	<10.0	10.0 to 14.9	≥15.0
(3) *Erythrocyte glutathione reductase activity coefficients* (All ages)	> 1.40	1.20 to 1.40	< 1.20

tion than random collections. Urinary excretion of thiamine decreases proportionately with thiamine intake to a critical point, after which further lowering of intake results in only minor and variable changes in urinary excretion.

In recent years, erythrocyte transketolase measurements have proved to be a useful indicator of early insufficiency of thiamine prior to the appearance of clinical manifestations. The measurement represents a functional test of thiamine adequacy and hence may be a more reliable indicator of thiamine insufficiency than urinary measurements of thiamine.

Levels of thiamine in blood have also been investigated and it is observed that whole blood thiamine levels less that 40 μg/100 ml are an indication of thiamine deficiency.

The guidelines which may be used for interpretation of the different biochemical indices in relation to thiamine status are listed in Table 4.

TABLE 4

Evaluation of Thiamine Status

Index	*Less than acceptable (at risk)*		*Acceptable (low risk)*
	Deficient (high risk)	*Low (medium risk)*	
(1) *Urinary excretion of thiamine* (μg/g creatinine			
1–3 years	< 120	120 to 175	≥ 176
4–6 years	< 85	85 to 120	≥ 121
7–9 years	< 70	70 to 180	≥ 181
10–12 years	< 60	60 to 180	≥ 181
13–15 years	< 50	50 to 150	≥ 151
Adults	< 27	27 to 65	≥ 66
Pregnant women:			
2nd trimester	< 23	23 to 54	≥ 55
3rd trimester	< 21	21 to 49	≥ 50
Adults: μg/24 hours	< 40	40 to 99	≥ 100
μg/6 hours	< 10	10 to 24	≥ 25
Load test (return in adults of 5 mg thiamine dose) μg/4 hours	< 20	20 to 79	≥ 80
(2) *Erythrocyte transketolase thiamine pyrophosphate stimulation Assay*: (Th PP stimulation) (All ages)	> 20%	16 to 20%	0 to 15%

5. NIACIN DEFICIENCY

Biochemical procedures for the evaluation of niacin status are not entirely satisfactory. The only practical index available is the measurement of urinary levels of N'-methylnicotinamide and 2-pyridone and expressing the results in terms of creatinine excretion and their ratio.

The guidelines for the interpretation of N'-methylnicotinamide excretion and 2-pyridone/N'-methylnicotinamide ratio are suggested in Table 5.

6. VITAMIN C DEFICIENCY

Although ascorbic acid has long been known to prevent scurvy, the precise biochemical functions of Vitamin C have remained obscure. In view of this, the biochemical evaluation of Vitamin C status has been conducted usually through the determination of serum ascorbic acid levels. Within a relatively limited range, serum levels of ascorbic acid

TABLE 5

Evaluation of Niacin Status (N′-methylnicotinamide excretion)

Subjects	*Deficient*	*Low*	*Acceptable*	*High*
Adults:				
(Males and non-pregnant non-lactating females)				
mg/g creatinine	<0.5	0.5 to 1.59	1.6–4.29	≥4.3
mg/6 hours	<0.2	0.2 to 0.59	0.6–1.59	≥1.6
Pregnant women: (mg/g creatinine)				
1st trimester	<0.5	0.5 to 1.59	1.6–4.29	≥4.3
2nd trimester	<0.6	0.6 to 1.99	2.0–4.99	≥5.0
3rd trimester	<0.8	0.8 to 2.49	2.5–6.49	≥6.5
All age groups:				
2-pyridone/N′-methyl-nicotinamide ratio	—	<1.0	1.0–4.0	—

show a linear relationship with the intake of Vitamin C.

The white blood cell levels of ascorbic acid provide information concerning the body stores of this vitamin. Information on the urinary levels of ascorbic acid and the use of Vitamin C loading tests can also be helpful in the clinical diagnosis of scurvy.

Guidelines for the interpretation of Vitamin C biochemical data for all age groups are shown in Table 6.

TABLE 6

Evaluation of Vitamin C Deficiency

Measurement Index	*Less than acceptable (at risk)*		*Acceptable (low risk)*
	Deficient (high risk)	*Low (medium risk)*	
(1) *Serum ascorbic acid* (mg/100 ml)			
(a) ICNND	<0.10	0.10 to 0.19	≥0.20
(b) Suggested revision	<0.20	0.20 to 0.29	≥0.30
(2) *White blood cell ascorbic acid* (mg/100 ml)	0 to 7	8 to 15	>15
(3) *Whole blood ascorbic acid** (mg/100 ml)	<0.30	0.30 to 0.49	≥0.50

* Classification may not be valid for subjects with marked anaemia.

7. VITAMIN D DEFICIENCY

Methods currently available for the measurement of Vitamin D or its metabolic products preclude direct measurements in blood or urine as a routine means of evaluating Vitamin D status, because of the unacceptability of any specific measurement to assess the adequacy of Vitamin D nutriture. Consequently, indirect measurements, such as serum alkaline phosphatase activity, are employed. Alkaline phosphatase activity generally rises early with the onset of rickets, even before clinical manifestations occur, and the increase tends to be proportional to the severity of the Vitamin D deficiency.

Rickets is generally associated with a decrease in blood levels of inorganic phosphorus and usually, but not always, with low calcium levels. Osteomalacia in adults is usually associated with a decrease in the concentration of serum calcium.

The approximate serum levels of alkaline phosphatase, calcium and phosphorus in the normal and in various disease states are outlined in Table 7.

TABLE 7

Serum levels of Alkaline Phosphatase, Calcium and Phosphorus

Condition	*Serum alkaline phosphatase (Bodansky Units per 100 ml)*	*Serum calcium (mg/100 ml)*	*Serum phosphorus (mg/100 ml)*
Normal:			
Infant	5 to 15	10	5 to 8
Adult	3 to 5	10	3 to 4.5
Rickets (Children)	>20	8 to 9	3
Osteomalacia	15	9	2 to 3
Hyperparathyroidism	4 to 20	12 to 16	2 to 8
Osteoporosis	2	10 to 12	4 to 5

8. IRON DEFICIENCY

For estimating iron insufficiency, measurement of haemoglobin is carried out most commonly because of the ultimate role of iron in this molecule.

The preferred method or basis is that which involves the conversion of all haemoglobin derivatives, except sulfhaemoglobin, to cyanmethaemoglobin using alkaline potassium ferricyanide and potassium cyanide.

The methodology for the estimation of haemoglobin is described in detail in Appendix V(B) as this is the most commonly carried out biochemical test in the field.

The direct measurement of iron in serum, together with the estimation of the degree of saturation of iron transporting protein (transferrin) is extremely useful in detecting iron deficiency states.

The relative saturation of transferrin or iron binding capacity may be approached by determining either total, unsaturated or latent iron binding capacity. The iron binding capacity estimate permits the distinction of nutritional deficiency from iron deficits due to infectious, inflammatory or neoplastic diseases.

The guidelines used for the interpretation of blood data are given in Tables 8 and 9.

TABLE 8

WHO Criteria for the Diagnosis of Anaemia

Determination	*Levels considered Anaemic or Iron Deficient*
Hb (g/dl venous blood):	
Children aged 6 months to 6 years	< 11
Children aged 6 to 14 years	< 12
Adult males	< 13
Adult females–non-pregnant	< 12
Adult females–pregnant	< 11
Serum iron (mcg/100 ml):	
Adults	< 50
Transferrin saturation (%):	
Adults	< 15

9. FOLIC ACID OR VITAMIN B_{12} DEFICIENCY

A number of biochemical measurements are available to provide information concerning the nutritional status of folacin in individual subjects. They include the assay of folate levels in serum, whole blood, red cells, leucocytes or liver biopsy specimens; the use of folacin loading tests; and the measurement of urinary excretion of formiminoglutamic acid (FIGLU), of urocanic acid or aminoimidazolecarboxamide.

It is essential in patients with megaloblastic anaemia that the precise deficiency be established (folacin and/or Vitamin B_{12}) before therapy is initiated. Serum Vitamin B_{12} and serum folacin levels should be determined as a minimum. If a normal Vitamin B_{12} level is observed in the presence of a low serum folate level, a diagnosis of pernicious anaemia is most unlikely. Low serum Vitamin B_{12} levels are indicative of pernicious anaemia and can be precisely established with the use of a Schilling test.

TABLE 9

Guidelines for the Interpretation of Iron Status

Age years	Sex	Haemoglobin (g/100 ml)			Hematocrit %			Serum Iron (µg/100 ml)		Transferrin Saturation (%)	
		Deficient	Low	Acceptable	Deficient	Low	Acceptable	Deficient	Acceptable	Deficient	Acceptable
<2	M-F	< 9.0	9 to 9.9	≥10.0	<28	28 to 30	≥31	<30	≥30	<15	≥15
2–5	M-F	<10.0	10 to 10.9	≥11.0	<30	30 to 33	≥34	<40	≥40	<20	≥20
6–12	M-F	<10.0	10 to 11.4	≥11.5	<30	30 to 35	≥36	<50	≥50	<20	≥20
13–16	M	<12.0	12 to 12.9	≥13.0	<37	37 to 39	≥40	<60	≥60	<20	≥20
13–16	F	<10.0	10 to 11.4	≥11.5	<31	31 to 35	≥36	<40	≥40	<15	≥15
>16	M	<12.0	12 to 13.9	≥14.0	<37	37 to 43	≥44	<60	≥60	<20	≥20
	F	<10.0	10 to 11.9	≥12.0	<31	31 to 37	≥38	<40	≥40	<15	≥15
Pregnant women:											
2nd trimester		< 9.5	9.5 to 10.9	≥11.0	<30	30 to 34	≥35	—	—	—	—
3rd trimester		< 9.0	9.0 to 10.4	≥10.5	<30	30 to 32	≥33	—	—	—	—

M = Males F = Females

Guidelines for the interpretation of serum and red blood cell folacin levels and of serum Vitamin B_{12} levels are given in Tables 10 and 11.

TABLE 10

Interpretation of Folacin Levels

Determination	*Less than acceptable (at risk)*		*Acceptable (low risk)*
	Deficient (high risk)	*Low (medium risk)*	
Serum folacin (All ages)	ng/ml <3.0	ng/ml 3.0 to 5.9	ng/ml ≥6.0
Red blood cell folacin (All ages)	<140	140 to 159	≥160

TABLE 11

Interpretation of Vitamin B_{12} Levels

Determination	*Less than acceptable (at risk)*		*Acceptable (low risk)*
	Deficient (high risk)	*Low (medium risk)*	
Serum Vitamin B_{12} level (pg/ml) (All age groups)	<150	150 to 200	≥200

10. IODINE DEFICIENCY

No simple biochemical tests are available, nor are they required, for standard goitre surveys. However, the laboratory evaluation of thyroid status can be made by determination of hormonal iodine in blood as protein-bound iodine (PBI), urinary excretion of iodine and radio-iodine uptake. In cases where there is a dietary insufficiency of iodine, the PBI and urinary iodine excretion are lowered and radio-iodine uptake is increased.

Serum PBI values for euthyroid individuals have generally been considered to fall in the range of 4.0 to 8.0 μg/100 ml. Urinary excretions of iodine of less than 50 μg/g of creatinine are assumed to be indicative of deficiency.

Appendix V(B)

METHOD FOR DETERMINATION OF BLOOD HAEMOGLOBIN

Haemoglobin is best measured by directly adding 20 μl of blood into Drabkin's solution. However, it is difficult to carry the complete apparatus for blood collection into the field. An alternative technique recommended by the NIN has been found reasonably satisfactory.

A measured amount of 20 μl of blood is accurately pipetted on to 1.5 × 1.5 cm Whatman No. 1 filter paper. This is allowed to dry. The filter paper is marked with a lead pencil and kept in a polythene bag. This filter paper can be despatched/carried to the laboratory at a convenient time during the next six days.

The blood is then eluted from the filter paper in 5 ml of Drabkin's solution for 2 hours. The tube is shaken well or preferably vortexed for about one minute and optical density measured by appropriate equipment.

If the same method is used before and after intervention, such as iron supplementation or iron fortification, the inferences with regard to the effects of intervention will not be influenced and are considered valid. A small but significant rise in haemoglobin concentration occurs as the filter papers are stored from day zero to day 7. If necessary, the interval between the collection of blood and the measurement of haemoglobin can be kept constant for all patients.

COLLECTION OF SPECIMENS

Capillary blood samples are used for haemoglobin estimations. The technique for skin puncture and sample collection is of prime importance as incorrect methodology leads to inaccurate results.

Equipment required

(1) Haemoglobin pipette
(2) Whatman No. 1 filter paper 1.5 × 1.5 cm
(3) Disposable lancet
(4) Spirit swab and gauze piece
(5) Glass test tube
(6) Drabkin's solution
(7) Vortex mixer
(8). Photoelectric colorimeter

Preparation of Reagents

Drabkin's solution: The following analytical grade reagents are required:

Potassium cyanide (KCN)	0.05 g
Potassium ferricyanide ($K_3 Fe (CN)_6$)	0.2 g
Dihydrogen potassium phosphate (KH_2PO_4)	0.14 g
Distilled water	to make 1 litre

Preparation: Dissolve 0.05 g of KCN, 0.2 g $K_3Fe(CN)_6$ and 0.14 g KH_2PO_4 in 1 litre of water. The reagent should be pale yellow, clear, with a pH between 7.0 and 7.4. The solution does not absorb any light above 480 nm and, therefore, gives the same reading as the water blank.

Storage: Store in tightly stoppered amber coloured glass bottles. Do not freeze. Discard if the solution turns turbid or has absorbance other than zero at 540 nm.

Stability: Drabkin's solution if stored in amber bottles is stable for several months.

Procedure

Selection of skin puncture site: In adults skin puncture is conveniently made on the centre of the palmar surface of the terminal segment of any of the first three fingers. Avoid puncturing the tip too close to the nail or the side of the finger.

In children less than four months of age, heel puncture is preferred. The selected site must be warm and free of oedema and infection.

Preparation of puncture site and method of puncture:

i. Reassure the patient. If the extremity is cold, warm the skin by vigorously rubbing the puncture site; this will increase the blood flow and improve sampling.
ii. Clean the selected site with a spirit swab and allow it to dry completely (alcohol causes haemolysis in the sample).
iii. Hold the finger firmly in a dependent position and apply gentle pressure just proximal to the puncture site.
iv. Use the lancet to puncture the skin at right angles to the direction of skin creases. This allows the blood to form a drop and prevents it from running into the skin creases.
v. Wipe the first drop away.

Collection of blood and Hb estimation:

i. Quickly place the tip of the haemoglobin pipette over the puncture and fill upto 20 μl level or slighty more.
ii. Once collection is over, elevate the finger and apply sufficient pressure to stop further bleeding.
iii. Wipe the outside of the pipette with a wet gauze. If the level of the blood is higher than the 20 μl mark, bring it to the exact 20 μl mark by absorbing the extra blood on a wet swab.
iv. Deliver the blood from the haemoglobin pipette on to the Whatman No. 1 filter paper.
v. Allow to dry and mark the filter paper with the identification number using a lead pencil. Air dry and keep in a polythene bag which also bears the identification number.
vi. Drop the filter paper into 5 ml of Drabkin's solution and allow it to stand for an hour. Vortex it for one minute and measure the optical density at 540 nm using Drabkin's solution blank and a commercial standard.
vii. Calculate the Hb in g/l by using the following formula:

$$\text{Hb g/l} = \frac{A^{540} \text{ of test sample}}{A^{540} \text{ of standard}} \times \frac{\text{Conc. of std. mg/l}}{1000} \times \text{dilution factor}$$

PREPARATION OF STANDARD CURVE

It is desirable to construct a standard curve for Hb by using reference HiCN calibration standards containing a known concentration of Hb in mg/l specified on the label. These are available commercially. The results of the test sample can then be read directly from the standard curve. The standard curve can be repeated at three-monthly intervals or whenever the instrument is repaired or lamp housing adjusted. A blood sample of low value can also be used for making standard curves.

Procedure

i. Using for example a HiCN calibration standard containing 80 mg/dl prepare serial dilutions as follows: Label a series of test tubes as 1, 2, 3, 4 and B. Pipette 5 ml of Drabkin's reagent into all except the first tube No. 1. Pipette 5 ml of distilled water into the tube labelled B (Blank).

Pipette 10 ml HiCN standard into the tube labelled 1. Pipette 5 ml of the standard from tube 1 to tube 2; mix well. Transfer 5 ml of this to the tube labelled 3. Mix well and transfer 5 ml of this to the tube labelled 4.

Use an appropriate filter for the colorimeter. Set the wavelength of

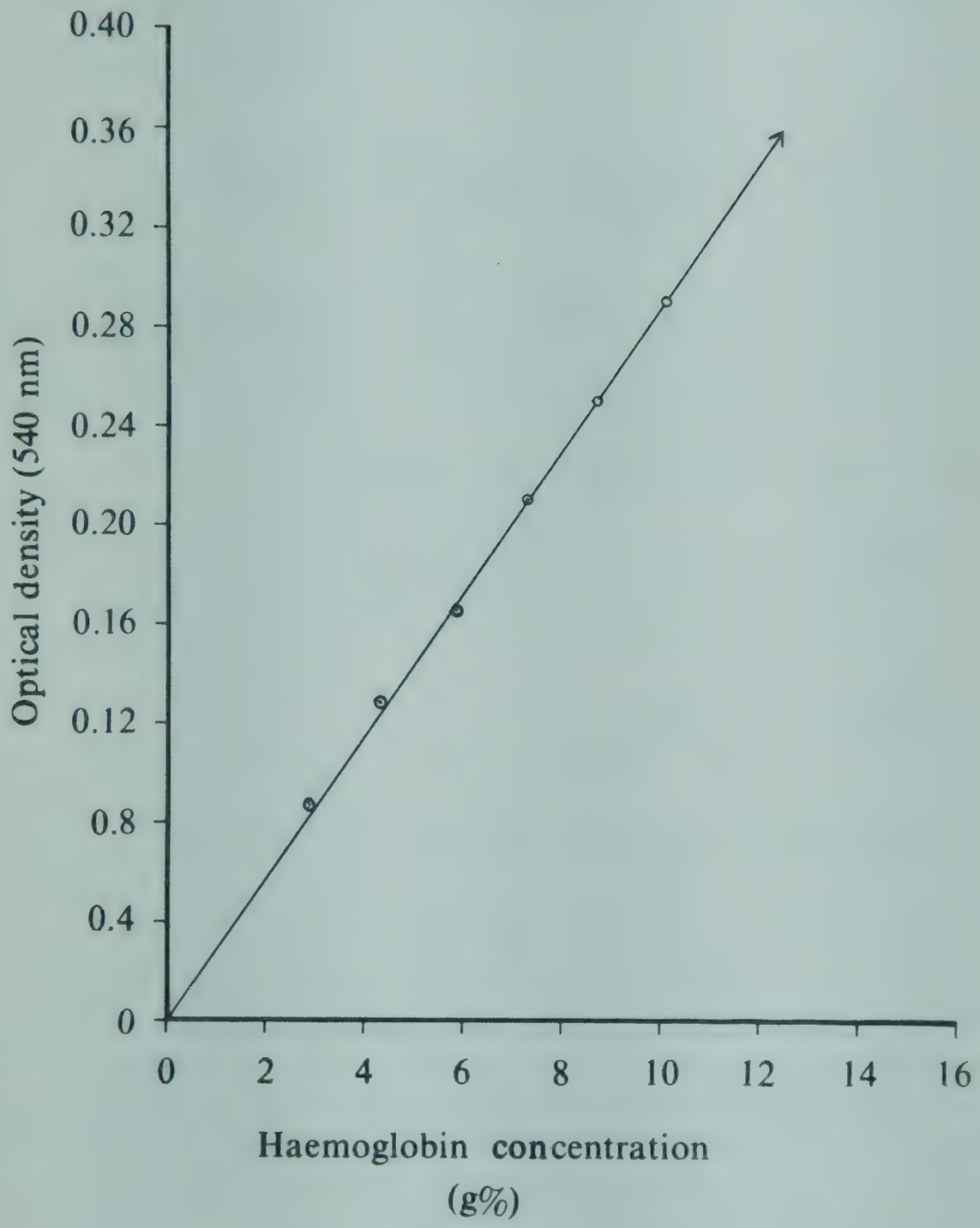
the spectrophotometer at 540 nm, and with appropriate cuvettes, check the instrument for zero and 100% transmittance.

ii. Read the standard against the reagent blank at 540 nm.

iii. To construct the standard curve, plot the absorbance values of standards on ordinary graph paper against the haemoglobin concentration in g/l on the abscissa. A straight line connecting the points should pass through zero (See Fig. 1).

STANDARD CURVE FOR HAEMOGLOBIN ESTIMATION

[CYANMETHAEMOGLOBIN METHOD]



Appendix VI

DIET SURVEYS IN THE ASSESSMENT OF NUTRITIONAL STATUS*

*SOURCE: Compiled by the Department of Foods and Nutrition M.S. University, Baroda.

Diet surveys constitute an essential part of any complete study of nutritional status of individuals or groups, providing essential information on nutrient intake levels, sources of nutrients, food habits and attitudes. The survey will also yield information regarding the economic and social factors influencing food production and consumption.

The methods commonly used are as follows:

(1) Family Food Questionnaire and Record Procedure
(2) 24-hour Recall Method or Interview Method
(3) Weighed Food Inventory
(4) Recipe Method
(5) Weigh-as-you-eat
(6) Food Composite Analysis Method.

(1) FAMILY FOOD QUESTIONNAIRE AND RECORD PROCEDURE

The questionnaire method involves distribution of questionnaires containing questions regarding the food items consumed, to the heads of the families and requesting them to fill them for a period of one week. The investigator collects the questionnaire after a week. She does not interview them or discuss the questions with them. This method provides information regarding the quantities of different food items consumed, the number of persons in the family etc., during the period of a week. This method cannot be used where the head of the family and the housewife are illiterate.

(2) 24-HOUR RECALL METHOD OR INTERVIEW METHOD

The subjects or respondents are asked to report the raw ingredients used for the whole family in the previous 24 hours which is recorded in

local volumetric measures or standard volumetric measures and later converted to grams or directly recorded in grams if possible. The volume of cooked foods is also recorded. The subjects consumption of the cooked foods is recorded in local or standard volumetric measures. These are then converted to raw weight of foods in grams and the nutritive value calculated using the Food Tables.

(3) WEIGHED FOOD INVENTORY

This is one of the most accurate methods and is recommended whenever sufficient trained personnel are available.

On the first day the investigator will weigh and record all quantities of food by kind or item in the home. As more food is acquired, she will weigh and record this quantity. The investigator will carefully question, observe and record all other food eaten in the home as well as outside the home. She will weigh and record all food discarded either before or after preparation.

At the end of the period of study, the amount of food wasted is added to the amount of food remaining in the home. These totals are subtracted from the total amounts of food in the home at the start and brought in during the period of study. By dividing this figure by the number of days of the study, one can arrive at the average daily food consumed by item or kind.

If the family members are all adults, dividing by the number of adults gives the average daily food weight consumption per person. If any special consumer categories are of interest, it is necessary to gather additional information like weighing and recording the portions of food served to each member of the family before consumption.

(4) RECIPE METHOD

This method consists of determining the quantity of each food item taken for cooking in the kitchen and also the weight of the cooked food. The cooked food left after consumption is also weighed. From these data, the actual quantity of food consumed by the family members can be calculated. The different steps are:

i. Prior to or at the start of the study, all cooking utensils to be used in the preparation of food are weighed and marked.
ii. The number of persons consuming the food should be recorded.
iii. All the raw food items used for cooking should be weighed and all the cooked food items should be weighed.
iv. After the food is consumed, the quantity of each food item remaining unconsumed should be weighed. Plate waste should also be recorded.

v. Based on the above data, the quantity of food consumed by the entire family can be calculated.

(5) WEIGH-AS-YOU-EAT

This method includes weighing the cooked food before eating it. The equipment used is an electronic weighing balance, which accurately measures the cooked weight of various dietary items before they are consumed. Based on the cooked weight and the recipe used for formulating the dish, the weight of the raw ingredients is arrived at. And on the basis of the amount of raw ingredients used, calculations are made for different nutrients such as calories, protein, fat etc.

(6) FOOD COMPOSITE ANALYSIS METHOD

This method involves sampling of each item served during breakfast, lunch, tea and dinner, as well as in between meals, with subsequent blending of representative samples and analysis for the various nutrients. About 10 per cent by weight of the foods consumed by one single individual can be taken as a sample. All the items are mixed and mashed to chemical analyses.

The raw food equivalents of cooked foods are given in Table 1.

TABLE 1

Raw Food Equivalents of Cooked Foods

Item	*Ingredient*	*Cooked Volume/Size*	*Raw Weight (g)*
(1) Chapati	wheat flour	1 small	20
		1 medium	30
		1 large	40
(2) Plain paratha	wheat flour	1 medium	30
	fat		5
	wheat flour	1 large	40
	fat		8
(3) Puri	wheat flour	1 medium	15
	fat		15
(4) Maize roti	maize flour	1 medium	100
	maize flour	1 large as made in tribal areas	200
(5) Khichri	rice	1 cup	25
	dal		25
(6) Rice	rice	1 cup	50
(7) Chana dal	chana dal	1 cup	45
(8) Kadhi	buttermilk	1 cup	54
	besan		3.5

TABLE 1—*Continued*

Item	*Ingredient*	*Cooked Volume/Size*	*Raw Weight (g)*
(9) Mung dal	mung dal	1 cup	50
(10) Tur dal	tur dal	thick 1 cup	50
		medium 1 cup	35
		thin 1 cup	15
(11) Spinach	spinach	1/4 cup	70
(12) Amarnath	amarnath	1/4 cup	55
(13) Fenugreek leaves	fenugreek leaves	1/4 cup	60
(14) Sweet potato	sweet potato	1/2 cup	85
(15) Potato	potato	1/2 cup	90
(16) Carrot	carrot	1/2 cup	80
(17) Bitter gourd	bitter gourd	3/4 cup	80
(18) Tindola	tindola (kovai)	1/2 cup	90
(19) Lady's finger	lady's finger	1/2 cup	90
(20) Yam	yam	1/2 cup	90
(21) Brinjal	brinjal	3/4 cup	90
(22) Cluster beans	cluster beans	1 cup	85
(23) Bottle gourd	bottle gourd	1/2 cup	90
(24) Peas	peas	1/4 cup	90
(25) Cauliflówer	cauliflower	1/2 cup	70
(26) Cabbage	cabbage	1 cup	95

Quantities indicated are in standard measuring cups. The volume of one cup = 200 ml.

Appendix VII

ASSESSMENT OF PROTOZOAL & HELMINTHIC INFESTATIONS

*SOURCE: Compiled by Department of Foods and Nutrition, M.S. University, Baroda.

Although the relationship between parasitic infestations and the host's nutritional status is controversial, yet it appears that the interaction of parasitism and nutrition is frequently synergistic and that moderate to heavy infestation with parasites impairs the nutritional status of the host by mechanisms such as causing impairment of enzymatic digestion and malabsorption of nutrients, competing for the host's nutrients, causing gastrointestinal loss of nutrients etc. Therefore, examination of stool forms an important part in the diagnosis of intestinal parasitic infestations and also for the detection of those helminthic parasites which localize in the biliary tract and discharge their eggs into the intestine.

In protozoal infections, either trophozoites or cystic forms may be detected; the former during the active phase and the latter during the chronic phase. Examples are amoebiasis and giardiasis. In helminthic infections, either the adult worms or their eggs are found in the stool. Examples are ascariasis, hookworm infection and trichuriasis.

A clear and specific relationship between parasitic infestation and anaemia has been demonstrated in the case of hookworm and, to a certain extent, Trichuris trichiura. Protozoans like Entamoeba histolytica and Giardia lamblia, as well as helminths like Ascaris lumbricoides are known to cause general malabsorption. Also, the intensity of parasitic infestation is of greater significance rather than the mere presence of parasites. It is now being realized that the significance of parasitic infestation depends on two factors: one—the nutritional status of the host, and the second—the worm burden. In view of this, the role of the presence and severity of parasitic infestation becomes increasingly important in determining the nutritional status of the host.

METHOD OF STOOL EXAMINATION

Fresh stool samples are collected in the morning in clean, sterile, plastic containers, and are examined for the presence or absence of parasitic infestation in the following manner:

Identification of parasites

Microscopic examination of a fresh stool sample may be carried out by using an unstained saline preparation as well as an iodine stained smear.

The unstained smear is prepared by placing a drop of freshly prepared normal saline in the centre of a clean dry grease-free slide. A portion of the stool is then picked up with a wooden toothpick and emulsified with the saline solution. A clean coverslip is then gently placed on top taking care to avoid air bubbles.

The iodine smear is prepared in a similar manner using a drop of iodine solution* in place of normal saline. Both the stained and unstained preparations are mounted on the microscope and examined—first under the low power lens, and then under the high power lens. The entire area under the coverslip is traversed systematically, first longitudinally and then horizontally. Two such preparations are scanned for the presence of cysts and trophozoites of E.histolytica and G. lamblia, as well as for ova of A. lumbricoides, A. duodenale and T. trichiura.

Assessment of eggs per gram of faeces (helminths)

The egg count is determined as follows:

4 g of faeces are mixed with 56 ml of 0.1 N NaOH in a thick glass tube and thoroughly mixed to make a uniform suspension. Exactly 0.15 ml of the emulsion is removed by a measuring pipette and placed on a large slide. A coverslip is then gently placed on the emulsion and the eggs of the helminths mentioned above are counted systematically by traversing the entire area under the high power lens of the microscope, using the mechanical stage. The counting is done on two such preparations, and the number of eggs per gram of faeces is obtained by multiplying the count by 100.

The consistency of the stool should be taken into consideration for which a correction factor may be employed to convert the estimate to a formed stool basis as follows:

Consistency	*Correction factor*
(a) Mushy formed stool	1.5
(b) Mushy stool	2.0
(c) Mushy diarrhoea stool	3.0
(d) Frankly diarrhoea stool	4.0
(e) Watery stool	5.0

* 10.09 g KI and 5.0 g I_2 crystals dissolved in 100 ml water.

Appendix VIII

INFORMATION ON VITAL STATISTICS: DEFINITIONS & DESCRIPTIONS*

*SOURCE: Park, J. B. and Park, K.: *Text book of Preventive and Social Medicine (A Treatise on Community Health)*. Banarsidas Bhanot, 1268, Napier Tower, Jabalpur, India.

(1) MORTALITY RATES

(a) *Death Rate*: is defined as number of deaths per 1,000 estimated mid-year population in one year. It measures the rate at which deaths are taking place from various causes in a given population, during a specified period.

It may be calculated from the following formula:

$$\text{Death rate} = \frac{\text{Number of deaths during the year}}{\text{Mid-year population}} \times 1{,}000$$

(b) *Maternal Mortality Rate (MMR)*: is the number of deaths from puerperal causes per 1,000 livebirths.

$$\text{MMR} = \frac{\text{Number of deaths directly due to pregnancy or childbirth and occurring during pregnancy or within 42 days of delivery}}{\text{Total livebirths in the year}} \times 1{,}000$$

(c) *Infant Mortality Rate (IMR)*: is the number of infant deaths under one year of age per 1,000 livebirths in any population in one year.

$$\text{IMR} = \frac{\text{Number of deaths under one year of age}}{\text{Total livebirths in the year}} \times 1{,}000$$

(d) *Neonatal Mortality Rate*: is defined as deaths occurring within 4 weeks or 28 days of birth

$$\text{Neonatal mortality rate} = \frac{\text{Number of deaths under 28 days of age}}{\text{Total livebirths}} \times 1{,}000$$

(e) *Post-Neonatal Mortality Rate*: is the death rate of infants dying from 28 days to under one year of age.

$$\text{Post neo-natal mortality rate} = \frac{\text{Number of deaths of infants 28 days to under one year}}{\text{Total livebirths}} \times 1{,}000$$

(f) *Perinatal Mortality Rate*: is the mortality occurring during the period from the 28th week of pregnancy to under 7 days of postnatal life, per 1,000 total births.

$$\text{Perinatal mortality rate} = \frac{\text{Late foetal deaths (28 weeks or more) + deaths under 1 week}}{\text{Total births}} \times 1{,}000$$

According to the revised definition suggested by WHO (1970), perinatal mortality should be calculated on the basis of the following formula:

$$\text{Perinatal mortality rate} = \frac{\text{Late foetal deaths + deaths under one week weighing over 1,000 g at birth}}{\text{Total births weighing over 1,000 g at birth}} \times 1{,}000$$

(g) *Stillbirth rate*: is the foetal deaths occurring after 28 completed weeks of gestation.

$$\text{Stillbirth rate} = \frac{\text{Number of foetal deaths at 28 or more completed weeks of gestation}}{\text{Number of livebirths}} \times 1{,}000$$

(2) MORBIDITY RATES

(a) *Incidence Rate*: is defined as the frequency of occurrence of new illnesses in a population.

$$\text{Incidence rate (persons)} = \frac{\text{Number of persons starting illness}}{\text{Population at risk}} \times 100$$

$$\text{Incidence rate (spells)} = \frac{\text{Number of new spells of illness}}{\text{Population at risk}} \times 100$$

The rate refers only to new cases, during a given period, in a specified population. The measurement may be related to persons who are ill or spells of illness that are experienced.

The term 'Population at risk' at a given time should include all those persons who would, in the event of their becoming

sick, be recorded as sick in the context of the particular enquiry.

(b) *Prevalence Rate*: is the total number of cases (old and new) at a given point of time. If the prevalence is recorded at a stated moment, it is called *point prevalence*, if it is recorded during a given period of time, it is called *period prevalence*.

$$\text{Point prevalence rate (persons)} = \frac{\text{The number of persons who are sick (old and new cases) at a given time}}{\text{Population exposed to risk at that time}} \times 100$$

$$\text{Point prevalence rate (persons)} = \frac{\text{The number of persons who are sick some time during a definite period}}{\text{Average number of persons exposed to risk during that period}} \times 100$$

(3) MEASUREMENT OF FERTILITY

(a) *Crude birth rate*: is defined as the number of livebirths during a year per 1,000 estimated mid-year population.

$$\text{Birth rate} = \frac{\text{Number of livebirths during the year}}{\text{Estimated mid-year population}} \times 1{,}000$$

Appendix IX

DEMOGRAPHIC DATA OF INDIA*

*SOURCE: Unicef: *An Analysis of the Situation of Children In India, 1984*. United Nations Childrens Fund, Regional Office for South Central Asia, New Delhi.

1. Total population	685,185,000	1981
2. Estimated child population		
0–6 yrs	125,826,000	1981
0–14 yrs	273,841,000	1981
3. Crude birth rate/1,000 population		
Rural	34.8	1981
Urban	27.3	1981
Total	33.3	1981
4. Crude death rate/1,000 population		
Rural	13.7	1981
Urban	7.9	1981
Total	12.5	1981
5. Infant mortality rate/1,000 livebirths		
Rural	124	1980
Urban	65	1980
Total	114	1980
6. Neonatal mortality rate/1,000 livebirths		
Rural	85	1978
Urban	38	1978
7. Perinatal mortality rate/1,000 livebirths		
Rural	52	1978
Urban	23	1978
Total	47	1978
8. Post-neonatal mortality rate/ 1,000 livebirths		
Rural	52	1978
Urban	36	1978

9. % Infant deaths to total deaths		
Rural	30.5	1976–78
Urban	23.6	1976–78
Total	29.7	1976–78
10. Neonatal tetanus incidence rate/1,000 livebirths		
Rural	16.6	1981
Urban	4.0	1981
Neonatal tetanus as a cause of death (%)		
Rural	39.2	1981
Urban	25.3	1981
11. % of poliomyelitis as a cause of lameness		
Rural	62.3	1981
Urban	67.6	1981
12. Prevalence rate of poliomyelitis/1,000 children 5–9 yrs		
Rural	6.4	1981
Urban	6.0	1981
13. Incidence rate of poliomyelitis/1,000 children 0–4 yrs		
Rural	1.7	1981
Urban	1.6	1981
14. Estimated maternal mortality rate/1,000 livebirths rural	4.68	1980
Causes of maternal mortality as % of total maternal deaths		
i. Abortion	12.5	1980
ii. Toxaemia	12.4	1980
iii. Anaemia	15.8	1980
iv. Bleeding of pregnancy & puerperium	15.8	1980
v. Malposition of child	13.4	1980
vi. Puerperal sepsis	12.4	1980
vii. Not classifiable	17.7	1980

Appendix X

LIST OF ABBREVIATIONS

Abbreviation	*Full form*
1. AID	Agency for International Development
2. AIIMS	All India Institute of Medical Sciences
3. ANM	Auxiliary Nurse Midwife
4. CARE	Cooperative for American Relief Everywhere
5. CBHT	Central Bureau of Health and Training
6. CHV	Community Health Volunteer (now renamed as Health Guide)
7. CMR	Crude Mortality Rate
8. CRL	Central Reference Laboratory
9. DES	Department of Economic Survey
10. DPT	Diphtheria, Pertussis & Tetanus
11. FAO	Food and Agriculture Organization
12. FFT	Fat fold at Triceps
13. FNB	Food and Nutrition Board
14. FY	Fiscal Year
15. GNP	Gross National Product
16. Hb	Haemoglobin
17. HiCN	Cyanmethaemoglobin
18. ICDS	Integrated Child Development Services
19. ICMR	Indian Council of Medical Research
20. ICNND	Interdepartmental Committee on Nutrition and National Defence
21. ICSM	Instant Corn Soya Milk
22. IMR	Infant Mortality Rate
23. KABNS	Knowledge, Attitude, Behaviour and Nutritional Status
24. KAP	Knowledge, Attitude & Practice
25. KCal	Kilocalorie
26. LFA	Least Favourable Assumption
27. LHV	Lady Health Visitor
28. MCH	Maternal & Child Heath
29. M & A	Monitoring & Assessment
30. MDM	Midday Meal

31. MFA	Maximum Favourable Assumption
32. MIS	Management Information System
33. MMR	Maternal Mortality Rate
34. MUAC	Mid-Upper-Arm-Circumference
35. NHE	Nutrition Health Education
36. NIN	National Institute of Nutrition
37. NIRD	National Institute of Rural Development
38. NNAPP	National Nutritional Anaemia Prophylaxis Programme
39. NNMB	National Nutrition Monitoring Bureau
40. NRC	Nutrition Rehabilitation Centre
41. NSS	National Sample Survey
42. NSSO	National Sample Survey Organization
43. PCI	Per Capita Income
44. PCV	Packed Cell Volume
45. PEM	Protein Energy Malnutrition
46. PEO	Programme Evaluation Organization
47. PHC	Primary Health Centre
48. PMR/PNMR	Perinatal Mortality Rate
49. RBP	Retinol Binding Protein
50. RDA	Recommended Dietary Allowance
51. SD	Standard Deviation
52. SFT	Skinfold at Triceps
53. SHC	Sub Health Centre
54. SNP	Special Nutrition Programme
55. TMR	Toddler Mortality Rate
56. UCLA	University of California, Los Angeles
57. UNICEF	United Nations, International Children's Emergency Fund
58. USAID	United States Agency for International Development
59. WFP	World Food Programme
60. WFS	World Fertility Survey
61. WHO	World Health Organization

Recommendations

At its conclusion the Workshop on Nutritional Monitoring and Assessment made the following recommendations:

1. Nutritional problems are multi-dimensional and therefore need to be tackled in a like manner. The goal of nutritional monitoring/assessment should be, not only to help the government with timely warning to undertake interventions, but also to provide data for long-term planning and nutrition programme management.

2. There is a need to develop a holistic approach to the concept of nutritional monitoring and evaluation. The concept should be understood by both the users (government) and the providers (monitoring and evaluation agencies) in the *same way*. The value of the concept is that it permits *early detection* of malnutrition in the vulnerable groups. This is its 'Why'. From this would flow the 'What' or 'Wherefores', namely, the development of overall and specific objectives; and finally the development of appropriate methods/tools and instruments.

3. It is essential to avail of the expertise of field statisticians to ensure sampling and statistical integrity. However, the final selection of the monitoring or assessment sample would depend on budget, staff and time constraints.

4. There are difficulties in using mortality data as an indirect indicator of nutritional status. If at all, it should be used as an additional indicator and never as a substitute for direct indicators of nutritional status. Among the various mortality indices—PMR, IMR, TMR and MMR—TMR is relatively more indicative of nutritional status than the others. In TMR the mortality rate in the second year of life is the most sensitive.

5. Process evaluation was considered an extremely important concept in nutritional monitoring and assessment. Cognizance was taken of the fact that monitoring (M) and assessment (A) of sequential stages such as logistical delivery, efficiency of delivery and receipt, and community participation in the entire delivery system had not received sufficient attention. Appropriate data bases and tools of measurement need to be developed. Management Information Systems could be based an such process evaluation models. Such MIS would ensure the speedier flow of vital information to the policymakers/administrators for the specific purpose of nutrition programme improvement.

6. The sensitivity, specificity, simplicity and cost of anthropometric parameters of weight/height and Mid-Upper-Arm-Circumference (MUAC) were considered. Of these, weight-age was considered the

most reliable; MUAC can be used in addition to weight-age and should be recommended in itself only if weight-age cannot be measured. Where possible height-age could also be recommended. Immediate attention should be paid to the manufacture of simple instruments (weighing scales and height meters), region-specific local events calendars, and accurate MUAC tapes in the quantity required. The use of the quack stick (age-independent) which is very economical and takes into account two anthropometric parameters (height and MUAC) should be seriously considered for school-age populations.

7. Among invasive parameters, as of now, *no* parameter has concomitantly satisfactory levels of both specificity and sensitivity. Haemoglobin estimation (cyanmethaemoglobin method) using the filter paper technique is probably the most useful parameter in the Indian context. Collections of timed samples of urine and blood, or even the collection of casual samples of urine and faeces was felt to be not feasible and wrought with storage and transportation problems. Cheap and portable instrumentation (especially haemoglobinometers) should be developed and production on a large scale should be encouraged.

8. Social indicators as of now are not too precise, sensitive, specific or simple to measure nutritional status. However, some indicators may be causally related such as occupation, land-holdings, family size, education, quality and quantity of water, sanitation, type of housing, type of family etc. Instruments have to be developed and refined to measure such relationships.

9. The school-age population deserves attention as a large demographic group for human resource development. The possibility of utilizing the very extensive network of primary schools of about half a million, at least that many teachers, and about 100 million children (6–15 years of age) for the collection of simple statistics on enrolment and attendance (especially of backward class children and girls) in relation to the availability of eligible children could be the first step. Simple weighment and detection of florid signs of nutritional deficiency may be attempted after adequately training teachers and older children. Nutritional evaluation could be conducted by trained teams on subsamples as and when required.

10. Nutrition health education was considered an important but as yet blurred area. The instruments of its measurement depend on subjective and not entirely objective responses. More attention should be paid to monitoring indicators such as trained personnel, availability and adequacy of NHE materials, exposure of the community to NHE and its receipt of the same rather than to KAP studies. Intermediate practices which are measurable should be developed. Anthropometric measurements may not reflect response to NHE, as NHE usually forms only a part of a comprehensive programme. Further, it is far more important

to train the trainer and the implementers of NHE programmes and to monitor and assess their knowledge, attitudes and practices, than to go to the community in the first instance.

11. In the NNMB reports it would be useful to represent anthropometric data in relation to International Reference Standards. In addition, data could also be represented in terms of weight-age classifications recommended by the Indian Academy of Paediatrics. The group recognized the very valuable work done by the NNMB and hoped that its activities could be extended to other states in the country.

12. A commonly agreed methodology needs to be developed for the collection of cost data. Indicators to express the economic benefits of nutrition programmes need to be developed. Additional low-cost inputs such as iron, Vitamin A supplements and de-worming should be considered for inclusion in ongoing supplementary feeding programmes and should be extended to *all* needy population groups.

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